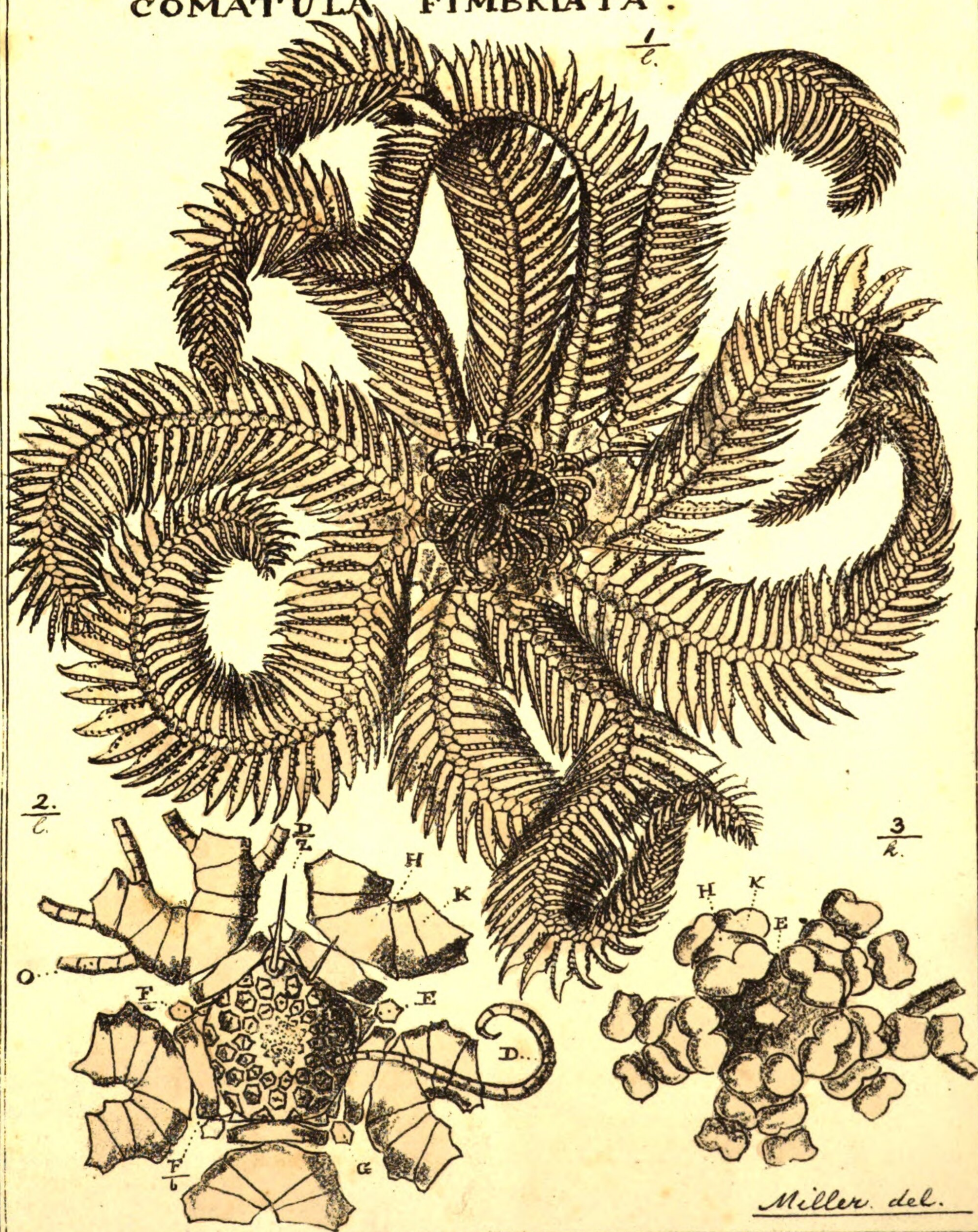


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16 G

COMATULA FIMBRIATA .



A
NATURAL HISTORY
OF THE
Crinoidea,
OR
LILY-SHAPED ANIMALS;
WITH
OBSERVATIONS
ON THE
GENERA,

Asteria, Euryale, Comatula & Marsupites,

ILLUSTRATED WITH FIFTY COLOURED PLATES.

BY
J. S. MILLER, A. L. S.

Miller
Crinoidea

“Comme rien ne peut exister s’il ne réunit les conditions qui rendent son existence possible, les différentes parties de chaque être doivent être coordonnées de manière à rendre possible l’être total, non-seulement en lui-même, mais dans ses rapports avec ceux qui l’entourent, et l’analyse de ces conditions conduit souvent à des lois générales tout aussi démontrées que celles qui dérivent du calcul, ou de l’expérience.”—M. LE CHEV. CUVIER Règne Animal, Tome 1, p. 6.

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76 G

NATURAL HISTORY

Chimæra

LILY-SHAPED ANIMALS;

OR

Antiquities of the Chimæra



Printed by G. Frost, Broad Street, Bristol.

Printed for the Author by G. Frost, Broad Street, Bristol.

1821.

Printed and Sold by G. Frost, Broad Street, Bristol.

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TO THE MEMBERS

OF THE

LINNEAN AND GEOLOGICAL SOCIETIES,

THIS WORK,

INTENDED TO ILLUSTRATE

THE HISTORY OF A CLASS OF ANIMALS

ESSENTIALLY CONNECTED WITH THE SCIENCES

WHICH IT IS THE OBJECT OF BOTH THESE INSTITUTIONS

TO PROMOTE,

IS MOST RESPECTFULLY INSCRIBED

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THE AUTHOR.

PREFACE.

IN an early stage of my inquiries into the structure of that interesting class of Animals which forms the subject of the present treatise, I had it in contemplation to limit them to the space of a brief memoir, which I had intended to submit to the Linnean Society ; as, however, these inquiries proceeded, aided by the acquisition of numerous new and important specimens, and by the kind contributions of my scientific friends, they gradually swelled to such a bulk (and more particularly the plates requisite for their illustration increased so greatly in number) that I could no longer flatter myself that a Society whose objects are so general, would deem it expedient to sacrifice so large a space in its transactions to a single branch of Natural History, and still less to incur on such an account, so great an expense as regular engravings of such numerous details would necessarily have entailed.

Under these circumstances, many of the friends to whose inspection I had submitted my collection of these remains, and whose acquaintance with the subject entitled their opinion to an high degree of deference, were kindly anxious that I should still communicate the result of my investigations to the Public, by offering on the terms of Subscription, a Monograph of this Class to which they related, and applying the slender talent of drawing I possessed, to executing myself the necessary illustrations in a series of Lithographical Plates, as the only mode in which a private individual could bring forward

such an undertaking, and one which, if less consistent with its beauty as a work of art, might yet, it was observed, bestow an additional degree of fidelity and precision on its anatomical details.

I did follow this advice, and it is to the kind exertions of the same friends that I stand chiefly indebted for the highly respectable list of Subscribers who have sanctioned this work by their patronage. Great, however, as is the encouragement I have derived from this circumstance, I still feel how much I must require the indulgence of the Public, in venturing to appear before it as an author and an artist, and especially on a subject so imperfectly understood as the present.

I trust, however, that I may fairly consider myself as having pointed out characters which throw a new and not unimportant light on the class of beings under consideration, which mark with precision the natural arrangements of their Genera and Species, and illustrate many of the most essential features of their organic structure; and since the elucidations hence resulting, offer in many and material instances new analogies, which may be usefully applied to the investigation of the other families of that important and hitherto imperfectly understood natural division, the radiated Echinodermata, I am willing to flatter myself that my researches may be considered as adding a useful, though humble, contribution to the now rapidly increasing stock of accurate Zoological knowledge.

Since the progress of these inquiries had brought to light numerous Species hitherto unknown or incorrectly ascertained, it became necessary to adopt, in part at least, a new nomenclature; from this consideration, and not from any desire of capricious innovation, which must, wherever it is superfluous, prove also detrimental to science, I have suffered myself to be swayed in this subject.

In the nomenclature I have thus proposed, I have therefore retained the old and familiar derivation of the classic name from the

Greek *κρινος*, a lily ; prefixing for the name of each genus another descriptive term from the same language ; thus hoping to produce an association of ideas which a simple generic appellation could not have conveyed, and which might become more readily impressed on the memory of the student.

I still, however, regret that it was not possible for me to avail myself of the very appropriate name *Stylastritæ* (from *στυλος*, a column, and *αετον*, a star, i. e. a stellated animal, supported on a column) proposed by Mr. MARTIN (the author of a work on the fossils of Derbyshire) in his outlines on the knowledge of extraneous fossils. This name happily describes not only the general resemblance, but also the place which this family should occupy in the natural arrangement of organized beings ; but being a compound term, would not have conveniently entered into any further combinations, and therefore would have failed in the object above specified. I cannot however pass it over without notice.

I have avoided imposing names on imperfect fragments which did not yield a clearly distinct specific character, since this would only have uselessly swelled the already voluminous nomenclature of natural history.

The anatomical descriptions are, in every instance, drawn up from actual and minute examination ; and it has been highly satisfactory to me, to have been able to verify and confirm the results obtained from the examination of fossil species, by comparison with the recent *Pentacrinus*, and to have found myself materially assisted by the analogies thus afforded, in investigating the allied genera *Marsupites* and *Comatula*.

As a native of the once free Hanseatic town of Dantzic, I felt myself long embarrassed by that imperfect knowledge of the peculiar idiomatic forms of English composition, which must be supposed

to present formidable obstacles against the success of a foreigner in every literary attempt. I have therefore submitted my manuscript to the revision of a gentleman who has taken a warm interest in assisting the prosecution of my inquiries. He has, however, in every instance, advised me to retain my own expressions unaltered, as conveying with the greatest fidelity and precision the ideas of my own mind, unless where, from the very different genius of the German language, they would have presented a meaning obscure, or liable to be mistaken by the English reader. These observations will at once account for, and it is trusted also plead for an indulgent allowance in behalf of, that occasional harshness of construction and style, which it is felt must still adhere to a work composed under such circumstances.

I have finally to acknowledge my obligations to the Very Rev. the Dean of BRISTOL; RICHARD BRIGHT, Esq. of Ham-Green; the Rev. W. D. CONYBEARE, of Brislington; the Rev. Professor W. BUCKLAND, of Oxford; the Rev. Professor A. SEDGEWICK, of Cambridge; the Rev. R. HALIFAX, of Standish; the Rev. Dr. COOK, of Tortworth; C. STOKES, Esq. of London; JOHN HAWKER, Esq. of Dudbridge; and to all the Gentlemen in Bristol and its neighbourhood possessing collections of organic remains, the richest perhaps in this department which England contains, for their liberality in furnishing me with specimens, and in giving every aid to my inquiries which a free access to their cabinets and the assistance of their valuable information could afford.

13, *Hillsbridge-Parade,*
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INTRODUCTION.

THE late inquiries made by M. CUVIER, LAMARCK, and other Naturalists in comparative anatomy, have extended the application of the results obtained, to the animal remains found in the various strata of our globe. Numerous genera and species of organic beings, of whose existence we had no previous idea, have been thus satisfactorily ascertained, whilst others still require persevering and patient examination; and it has been proved, that by a thorough knowledge of them, greater certainty may be given to the facts resulting from geological observations.

As the environs of Bristol abound in strata replete with organic remains, I was induced by these considerations to devote to them a large share of my attention. The columns of the Encrinite so abundant in the black rock, (a fetid mountain limestone) on the side of the river Avon, attracted my notice particularly, and the sparry subrotund concretions dispersed throughout the rock, made me hope that I might find in these the superior extremities of that animal which had been generally sought for in vain. This suspicion was soon after verified by the discovery of the fine specimen of ACTINOCRINITES 30 DACTYLUS figured PL. II. fig. 1. and 2. A perusal of Mr. PARKINSON'S work on the Organic Remains of a former World, showed how much had been done, and what remained to be done, for the illustration of the history of the Encrinites, and M. CUVIER'S method in the identification of animals by their skeletons, pointed out the mode to be pursued. I began therefore to collect as many masses and fragments of these animals as I could get. I extended my field of research gradually further around the environs of Bristol, to the Transition and Mountain Limestone, the Lyas, Oolite, Greensand, and Chalk: and began to arrange the specimens obtained according to the strata and places where found. A few of these more perfect and illustrative than the rest, enabled me to form an idea of the relative

position and arrangement of the numerous fragments in my possession, and to make with these (as it were) disjointed skeletons. These fragments which presented me often with characters, that in more perfect specimens are partially concealed, pointed out that something more than the bony portion (or rather internal bonelike concretions of these animals, which must in this respect be considered as analogous in structure to the Star-fish) had been preserved, and had sustained the process of petrification, and that traces of muscular covering investing them were clearly observable. I was thus led to an inquiry into the myology of these beings, which combined with the former observations, aided in obtaining a more satisfactory knowledge of their economy, and a more correct determination of their genera and species. I was much pleased, when on a subsequent examination of the *Pentacrinus caput medusæ* (the only recent, and very rarely occurring species) I was confirmed in the correctness of the conclusions which I had deduced from the inspection of the fossil fragments. The course of these researches convinced me that the animals described by Mr. PARKINSON as *Encrinites* and *Pentacrinites*, and by M. LAMARCK and M. CUVIER arranged under the single genus, *Encrinus*, would readily and properly form a distinct and peculiar family, comprehending several genera and species. The new order thus constructed, requires to be separated from the *POLYPI NATANTES* of M. LAMARCK—an order to which its members were most unhappily referred by that author, although they possess neither of the characters indicated by that name, being in truth widely different from *Polypi*, and instead of floating freely, being generally fixed to one spot. They form the natural transition to the *stelleridæ* family, but especially to the genera *ALECTO* of Dr. LEACH, and *MARSUPITES* of GIDEON MANTELL, Esq.

As the Zoological principles adopted in this Work coincide generally with those of M. LAMARCK, but yet in many instances, exhibit modifications of them, which would appear inadmissible were his opinions implicitly embraced; it will materially assist us in forming a clear view of the place which is assigned to the present order in the scale of animated nature, and illustrate the observations which it may be necessary hereafter to introduce; to subjoin in this place a brief review of that part of the system of this author, (who proceeds from the lower and most simple to the more complicated and perfect animals) which includes his lowest classes, those namely, which precede and accompany that in which he places the genera of which we are now entering upon the description. We must begin then by observing, that according to

M. LAMARCK, in the beings placed in the lowest or first stage of animal life, we are unable to discover organs which demonstrate the existence of sensation, a mere irritability of fibre is the whole that is allowed them according to this view; it is said that no brain, or nervous system proceeding from it can be traced, and the inference that they possess no consciousness or volition is hence hastily drawn. Yet if we argue with minds unprejudiced by metaphysical systems, from the obvious phenomena, and guided by the first rules of philosophizing, ascribe (in the absence of all direct evidence to the contrary) similar effects to similar causes; we cannot, I am persuaded, hesitate to ascribe these faculties to the animals in question; whether they depend in them on some new and peculiar organization, or whether (which considering our imperfect means of observation may well be supposed to be the case) they actually possess a nervous system, which, from its minuteness and distribution through their frame, has as yet eluded our discovery. The vorticella, disturbed by the rays of light or want of food, hurries along till it ceases to feel the cause that agitated it. Does this not demonstrate the sense of feeling? The irritability of the stomach excited by hunger alone, could not spread the numerous tentacula of the Polypi to ensnare its prey, and compel these to retain it and guide it to the mouth: no, this demonstrates consciousness.

The arrangement of M. LAMARCK commences with the simplest forms of animal life; his first class consists of the INFUSORIA, or animals which may be discovered in various infusions. The beings it contains are so minute, that before the invention of the Microscope, we had no idea of their existence; and even now we know them very imperfectly. They are nevertheless highly interesting, and demonstrate conspicuously how very minute an atom of matter must be, that is capable of entering into their organic system, and being appropriated to their wants. Were it not for the conviction of the imperfect knowledge we possess of these animals, and the insufficiency of our means to obtain it, we might be almost led to doubt their continued propagation, and to have recourse to the supposition of a spontaneous generation; but under these circumstances an hypothesis so contrary to the general analogies of all animals which we have a full opportunity of observing, cannot rashly be admitted.

The POLYPI constitute the next class of M. LAMARCK, and form a large family of animals, in which we trace a gradual progress to a more compli-

cated organization. They, according to that author, have a gelatinous contractile body, a distinct mouth, surrounded by tentacula, or branching arms, and a simple alimentary canal or stomach, showing no vents; they increase by separation or internal spontaneous productions, and show no generative organs. The greater part of the species adhere one to another, and may be considered as animals depending on mutual support. Some of them approach closely to the infusoria (*POLYPI CILIATI*) whilst others more distinctly formed (*POLYPI DENUDATI*) are capable of attaching themselves by means of a pedicle, and in many instances able to detach and affix themselves to new spots.

The *POLYPI VAGINATI* are gelatinous like the former, but possess an epidermis, capable of secreting horny or calcareous matter, which furnishes them with a point of attachment. (*SERTULARIA*); with a sort of skeleton for the support of their aggregate and clustered groups, (*GORGONIA*); or which forms cells in which the animal may partially conceal itself or retreat. The Polypi of this order, some of which are very minute, form those elegant corneous plantlike skeletons and calcareous *POLYPARIA* (as these cases investing the Polypi are termed by Lamarck) which so frequently occur in the cabinets of scientific collectors, and from whose different configurations, characters have been derived which have enabled Naturalists to arrange them into different genera, as *MADREPORES*, *MILLEPORES*, *TUBIPORES*, &c. The fabrics of animals of this order, occasion those coral reefs, so frequent in the seas of the southern hemisphere, which, being first elevated by the spoils of successive generations to the surface of the water; then covered with sand derived from their own detritus, and that of sea shells; and lastly, affording a lodgment to seeds casually wafted; in time assume the character of verdant islands. Thus strangely do the minutest and seemingly least important inhabitants of the ocean become the parents of new tracts of land. Their remains in earlier ages have contributed, in many instances, to form those masses which constitute the rocky strata of our present continents, and they are to be found in great variety and abundance in the very first formations that exhibit any remains of the animal kingdom.

Passing by LAMARCK'S *POLYPI TUBIFERI*, we come to his *POLYPI NATANTES*. It is in this order, which appears to me ill defined, that he places together with the genera *PENNATULA*, *VIRGULARIA* and *UMBELLULARIA*, the genus *ENCRINUS*, describing two species, the *ENCRINITES MONILIFORMIS* and the *PENTACRINUS CAPUT MEDUSÆ* of the present Monograph. The character of

the order as laid down by him, "Many Polypi united to an elongated free fleshy living body, containing an inorganic axis" does not apply to the genus *ENCRINUS*, and the definition he gives of this genus itself is also erroneous, in stating that "The branches forming the umbel are filled with Polypi in rows." These errors of M. LAMARCK's are omitted in M. CUVIER's *REGNE ANIMAL*, where, however, he gives no new generic character, but only places the genus *ENCRINUS* after the *ASTERIÆ*, in the division *ZOOPHYTES*, class *ECNINODERMES* and order *PEDICELLES*. I must acknowledge I do not know why M. CUVIER should have suppressed the name *VERMES* applied by LINNÆUS to the sixth class of animals, and preferred the term *ZOOPHYTES*, adding "OU ANIMAUX RAYONNES," the Greek word so translated means *PLANTLIKE ANIMALS*. The Swedish Naturalist used it, I think with propriety, to denominate his fourth order of *VERMES* containing the Polypi of LAMARCK, because their own figure and that of their Polyparia bore a great resemblance to plants; but I cannot see the reason why it should be thus extended to designate a division containing the *ECHINI*, *INTESTINAL WORMS*, *INFUSORIA*, &c.

the order as laid down by him, "Many Polyp" united to an elongated free
fleshy living body, containing an inner axis" does not apply to the genus
Ectocarpus, and the definition he gives of this genus itself is also erroneous,
in stating that "The branches forming the umbel are filled with Polyp in
rows." These errors of M. Lamarck's are omitted in M. Cuvier's History
Animal, where, however, he gives no new generic character, but only places
the genus Ectocarpus after the Astaria, in the division Zoophytes, class
Echinodermes and order Echinodermata. I must acknowledge I do not know
why M. Cuvier should have suppressed the name Vermetus applied by
Linnaeus to the sixth class of animals, and pretitled the term Zoophytes,
adding "On Animals Rayonnes," the Greek word so translated means
Plumbeous Animals. The Swedish Naturalist used it, I think with propriety,
to designate his fourth order of Vermetus containing the Polyp of Lamarck,
because their own figure and that of their Polyparia bore a great resemblance
to plants; but I cannot see the reason why it should be thus extended to
designate a division containing the Echini, Infusoria, worms, Insecta, &c.

8

Family.

CRINOIDEA.

LILY-SHAPED ANIMALS.

Character of the Family.

AN animal with a round, oval, or angular column, composed of numerous articulating joints, supporting at its summit a series of plates or joints forming a cup-like body containing the viscera, from whose upper rim proceed five articulated arms, dividing into tentaculated fingers, more or less numerous, surrounding the aperture of the mouth, situated in the centre of a plated integument, which extends over the abdominal cavity, and is capable of being contracted into a conic or proboscal shape.

Some species of these animals ascertained to be permanently attached to extraneous bodies, whilst others appear to have been capable of locomotion.

Derivation of the Name of the Family.

I have derived the name of this family from the Greek ΤΑ ΖΩΑ ΚΡΙΝΟΕΙΔΕΑ the lily-shaped animals, and have used this word to form with another distinguishing term prefixed, the name of the genera.

Progress of the Study of the Animals now arranged in this Family.

The columns and columnar joints of the Crinoidea, by their frequent occurrence and remarkable figure, have attracted the attention of naturalists at an early age. The round columns, and their depressed single perforated joints, marked upon their upper and lower surfaces with radiating striæ, have acquired names

founded on superstitious ideas, their resemblance to other bodies, and the use they were applied to; as rosary beads, (*Rosenkranzsteine*, Germ.) giant's tears, (*Bunnenthaenen*, Germ.) fairy stones, wheel stones, (*Raedersteine*, Germ.) torchites, entrochites, &c. The angular columns being generally star-shaped received the names starstones, *asteriæ*, &c.

AGRICOLA considered these bodies as inorganic infiltrations, similar to stalactites. Other early authors regarded them as vertebral joints of fish, as corals, &c.; and some who had more accurately observed the column and its termination, compared them to plants, whence the name of the stone lily (*Stein Lilie*, Germ.) was given to the superior extremities of our genus *ENCRINUS*. LLHUIDI believe first considered them as appendages to star fish; and when this idea was accepted by men of enquiry, and it was admitted, that they probably belonged to the *asteria*, (now the *STELLERIDES EURYALE* of M. LAMARCK,) and might even exist in unexplored seas, researches were set on foot to discover them in a living or recent state. A recent species of these animals was supposed to have been detected, when the *PENNATULA ENCRINUS* of the immortal LINNÆUS, of which ELLIS gives a description as an hydra, was first noticed. But this, on closer examination, proved to differ so materially from the *ENCRI-NITE*, that it furnished LAMARCK with the type of his new genus *UMBELLULARIA*. Soon afterwards, however, a portion of an animal was found which bore a great resemblance to the *asterial* columns occurring so frequently in *lias* and *oolite*, possessing, indeed, an absolute identity of generic characters. LINNÆUS improperly classed this species under the genus *ISIS*, as *ISIS ASTERIA*, which error M. LAMARCK corrected, and placed it in his genus *ENCRINUS*, as *ENCRI-NUS CAPUT MEDUSÆ*, and which I have removed to the genus *PENTACRINITES* (*Pentacrinus*) retaining M. LAMARCK's specific name.

Geological Distribution of the Crinoidea.

Some species, as *CYATHOCRINITES rugosus*, &c. are found amongst the earliest traces of organic remains, imbedded in the transition limestone formation. Other species of the genera *ACTINOCRINITES*, *PLATYCRINITES*, *RHODOCRINITES*, *POTERIOCRINITES*, and *CYATHOCRINITES*, occur in the mountain and magnesian limestone deposits, where they are lost, (as far as I have been able to ascertain,) and make room for the different species of *PENTACRINITES*, which may be traced through the beds of the *lias*, *oolite*, and *chalk*, and of which one species, the *PENTACRINUS CAPUT MEDUSÆ*

has continued from the formation of the Iyas to our times, and is now met with, though very rarely, in a recent state. The *APIOCRINITES ROTUNDUS* is only found adhering to a bed of the oolite formation, and the *APIOCRINITES ELLIPTICUS* in chalk.

It also appears that many species of Crinoidea have been very generally distributed over our earth, whilst others (at least as far as our knowledge extends) were more local.

Observations.

The essentially distinguishing character of the family of Crinoidea, is the column formed of numerous joints which separates them from the Polypi, whilst the arms and fingers surrounding the mouth, prove their affinity to them and the *STELLERIDÆ*.

The integuments of the Crinoidea appear to have had the power of forming by secreting a number of calcarious concretions, forming joints or ossicula, composing what may be termed the skeleton of the animal. These cannot, indeed, with strict propriety, be termed bones, since that denomination is almost limited by usage to the parts constituting the skeleton of vertebral animals, whereas the ossicular concretions of the Crinoidea in many points (and probably also in their chymical composition) bear a nearer analogy to the plates of the Echinus and the joints of the Star-fish. Yet entirely different both in disposition and arrangement, as are these ossicula from the bones of vertebral animals, they manifestly are intended to subserve the same general uses, to form the solid support of the whole body, to protect the viscera, and as we shall presently see reason to believe, to form the basis of attachment to a regular muscular system. Having thus guarded my use of the term ossicula against the misapprehension or objections that might otherwise possibly arise, I shall, without scruple, employ that appellation to designate these bodies. By the depressions and foramina in the ossicula, it may be proved that the gelatinous integument investing them possessed muscular powers, and was able to produce effects resulting from muscular action. The movement of the arms, the fingers, and tentacula, could only have been effected in this manner.

A Periosteum seems to have secreted and arranged the calcarious matter of the ossicula, and I think in some instances had the power of reabsorbing it.

This last quality may account for the enlargement of the alimentary canal in the columns of the *ACTINOCRINITES*, *CYATHOCRINITES*, &c. as the animal increased in size.

On the summit of the column are placed series of ossicula, which, from their position and uses may be termed the pelvis, scapula, costal, and intercostal joints or plates, varying in their number, and partly wanting in some genera. These form (with the pectoral and capital plates) a kind of subglobular body, having the mouth in its centre, and containing the viscera and stomach of the animal, from which the nourishing fluids are admitted through a sphincter muscle to the alimentary canal in the column, and also carried to the arms and tentaculated fingers.

These ossicula, when possessing a short and thick figure, and connected by regular articulating surfaces, as in *APIOCRINITES*, or occasionally perhaps, anchylosing together, as in *EUGENIACRINITES*, I have denominated joints; when they assume a thinner and flatter form, and adhere only by sutures, lined by the muscular integument, as in *ACTINOCRINITES*, I have termed them plates.

The difference of these modes of structure have enabled me to form four divisions of the family of Crinoidea; and as the number of plates or joints on which the scapula rests, as also the number of fingers and arrangement of finger bones varies, these, with the shape of the column, offer good characters to form genera and determine species.

The food of the Crinoidea we may conjecture to have consisted in animals less solid than themselves, probably infusoria, polypi, medusæ, &c. This indeed is rendered more certain by their possessing in their numerous tentaculated fingers, such an admirable net-like apparatus for the detention of minute substances, since it is a rule in nature to suit always in its organic formations the mechanism to the wants. The small mouth capable of elongating into a kind of proboscis, also aids in confirming this conjecture.

I apprehend that the Crinoidea propagated by eggs only, their complicated organic construction (so widely differing from that of the *STELLERIDÆ*) not permitting increase by separation of parts of the animal, or by buds, as is said to be the case in Polypi, whose young are said to push forth from the sides of the gelatinous contractile body. The inference drawn from this alleged fact,

however, appears to me, I confess, doubtful; and I am rather inclined to believe that near the place where the young Polypi appear to push forth, the aperture of the ovary exists, from which the minute ovum having escaped, and by means of its gluten adhering to the parent, thus forms a sort of placenta from which the extruded animal draws for a period its vital sustenance. I suspect that I have detected the aperture or apertures of the ovaries in *APIOCRINITES ROTUNDUS*, between the angles near the adhesion of the joints of the pelvis and costæ, as also in the division of *INARTICULATA* between the scapula.

Whether the Crinoidea did or did not possess a vent, still remains doubtful. Their organization appears to have been such as might, perhaps, have enabled them to dispense with this part; since the sphincter muscle at the bottom of the stomach (the apex of the column) permitted, probably, only those juices to pass into the alimentary canal which were destined to be assimilated into the system, and matter, not so applicable, may easily have been disgorged by the mouth. Even the juices carried into the alimentary canal, too abundant for the general recrements needed by the animal frame, may have been exuded through vessels between the joints, and have been employed in repairing occasional injuries, or forming additional lamina to strengthen the fabric.

The liability to frequent accidents to which animals formed of such numerous parts as the Crinoidea must be exposed, renders their having a power of repairing injuries sustained, and of reproducing portions lost, necessary; and that they have this is verified, beyond doubt, by the specimen of *PENTACRINUS CAPUT MEDUSÆ*, recently in the possession of the late John Tobin, Esq.

The mode in which the numerous ossicular concretions of these animals are connected together by a gelatinous muscular substance only, renders their separation after death easily accounted for, and explains the rare occurrence of perfect specimens in a fossil state. The formation of all the ossicula by calcareous secretions, furnishes the reason why they have been so perfectly preserved in the mineral strata, although changed into foliated spar similar to that which generally occurs in the remains of Echini and Asteria.

Where the muscle is preserved, or a portion of the animal oil, however minute, intervenes between the fossil and the imbedding substance, or between two joints, they easily separate, and if exposed to the gradual action of an acid, not unfrequently muscular fibre itself may be developed.

Division and Classification of the Crinoidea.

In the proposed arrangements of the members of this family they will be classed under four principal divisions, comprising altogether nine genera, each containing several species, as particularized in the annexed table.

It is almost unnecessary to observe that a previous perusal of the detailed account of the genera and species will be requisite, in order to furnish a clear understanding of the synoptical and abridged view of their characters presented in the following table. The employment of letters of the same type, and references of the same figure, to denote in every instance the characters taken from the same parts, proceeds exactly upon the plan adopted by M. LAMARCK, and will be at once understood by those familiar with his mode of arrangement.

Systematic Arrangement of the Crinoidea.

* The Etymology of the names adopted will be found in the description of each genus and species.

I. DIVISION. ARTICULATA. Joints forming the superior cup-like body of the animal articulating to each other.

A Pelvis formed of five joints.

a Supporting five costal joints.

a Column enlarging at the summit.

a Fingers formed of a single series of joints.

I. GEN. APIOCRINITES.

* Column round

o Alimentary canal round.

§ Articulating surface of columnar joints radiated. 1 *Sp. rotundus*.

** Column elliptic.

o Alimentary canal round.

§§ Articulating surface of columnar joints transversely ridged.

2 *Sp. ellipticus*.

b Column not enlarging at the summit.

a Fingers formed of a single series of joints.

*** Column pentangular.

o Alimentary canal round.

§§§ Articulating surface of columnar joints petal-shaped.

III GEN. PENTACRINITES.

† Auxiliary side arms round.

‡ In single series.

|| Column smooth.

1 Columnar joints generally alternately smaller and larger.

1 *Sp. Caput Medusæ*.

2 Columnar joints generally of more uniform thickness.

4 *Sp. Basaltiformis*.

||| Column tuberculated.

5 *Sp. tuberculatus*.

‡‡ Auxiliary side arms in double series.

|| Column smooth.

3 *Sp. subangularis*.

†† Auxiliary side arms angular.

‡ Auxiliary side arms in single series.

|| Column smooth.

2 *Sp. Briareus*.

5 Fingers formed of two series of joints.

* Column round.

o Alimentary canal round.

II. GEN. ENCRINITES.

1 *Sp. moniliformis.*

II. DIVISION. SEMIARTICULATA. Plate-like joints forming the superior cup-like body of the animal, articulating imperfectly to each other.

A Pelvis formed of five joints

3 Supporting five costal plates.

a Column not enlarging.

3 Fingers formed of a single series of joints.

* Column round.

o Alimentary canal round.

§ Articulating surface of columnar joints radiated.

† Auxiliary side arms round.

‡ Auxiliary side arms placed irregular. IV. GEN. POTERIOCRINITES.

1 Joints of fingers thick.

1 *Sp. crassus.*

2 Joints of fingers slender.

2 *Sp. tenuis.*

III. DIVISION. INARTICULATA. Plates forming the superior cup-like body of the animal, adhering by sutures, lined by muscular integument.

N. B. In a young state POTERIOCRINITES TENUIS may be erroneously considered as belonging to this family, on account of the undeveloped state of the articulations.

A Pelvis formed of five plates.

3 Supporting five costal plates.

a Column not enlarged.

3 Fingers formed of a single series of joints.

* Column round

o Alimentary canal round.

§ Articulating surface of columnar joints radiated.

† Auxiliary side arms round.

‡ Auxiliary side arms placed irregular. VI. GEN. CYATHOCRINITES.

- 1 Costal plates smooth. 1 *Sp. planus.*
- 2 Costal plates tuberculated. 2 *Sp. tuberculatus.*
- oo Alimentary canal petal shaped.
- § Articulating surface of columnar joints radiated.
- † Auxiliary side arms round.
- ‡ Auxiliary side arms placed irregular.
- 1 Costal plates with angular rugged striæ. 3 *Sp. rugosus.*
- ** Column pentangular.
- ooo Alimentary canal pentangular.
- § Articulating surface of columnar joints radiated.
- † Auxiliary side arms round.
- ‡ Auxiliary side arms placed irregular.
- 1 Costal plates smooth. 4 *Sp. quinqu angularis.*
- B Pelvis formed of three plates.
- B Five costal and one intercostal plate resting on the pelvis. VII. GEN. ACTINOCRINITES.
- b Column not enlarging near the summit.
- b Fingers formed of two series of joints.
- * Column round.
- o Alimentary canal round.
- § Articulating surface of columnar joints radiated.
- † Auxiliary side arms round.
- ‡ Auxiliary side arms irregular.
- 1 Thirty fingers proceeding from five scapulæ. 1 *Sp. triacontadactylus.*
- 2 More than thirty fingers proceeding from five scapula. 2 *Sp. polydactylus.*
- C Five intercostal plates, resting on the pelvis, in whose lateral angles five costal ones insert. VIII. GEN. RHODOCRINITES.
- b Column not enlarging near the summit.
- b Fingers formed of two series of joints.
- * Column round.
- oo Alimentary canal petal shaped.
- § Articulating surface of columnar joints radiated.
- † Auxiliary side arms round.
- ‡ Auxiliary side arms irregular. 1 *Sp. verus.*
- D Costal, or intercostal plates wanting the five scapulæ, adhering to the pelvis. V. GEN. PLATYCRINITES.
- b Column not enlarging near the summit.
- b Fingers formed of two series of joints.

**** Column elliptic.**

o Alimentary canal round.

§§ Articulating surface of columnar joints transversely ridged.

† Auxiliary side arms round.

‡ Auxiliary side arms placed irregular.

1 The five scapulæ smooth, having each four fingers.

1 *Sp. lævis.*

2 The five scapulæ rugose, having each six fingers.

2 *Sp. rugosus.*

***** Column pentangular.**

ooo Alimentary canal pentangular.

§ Articulating surface of columnar joints radiated.

† Auxiliary side arms round.

‡ Auxiliary side arms irregular.

1 The five scapulæ smooth.

6 *Sp. pentangularis.*

***** Column not known.**

1 The five scapulæ tuberculated.

3 *Sp. tuberculatus.*

2 The five scapulæ granulated.

4 *Sp. granulatus.*

3 The five scapulæ striated.

5 *Sp. striatus.*

IV. DIVISION. COADUNATA. The joints of the pelvis ankylose to the first columnar joint.

A Pelvis formed of five joints.

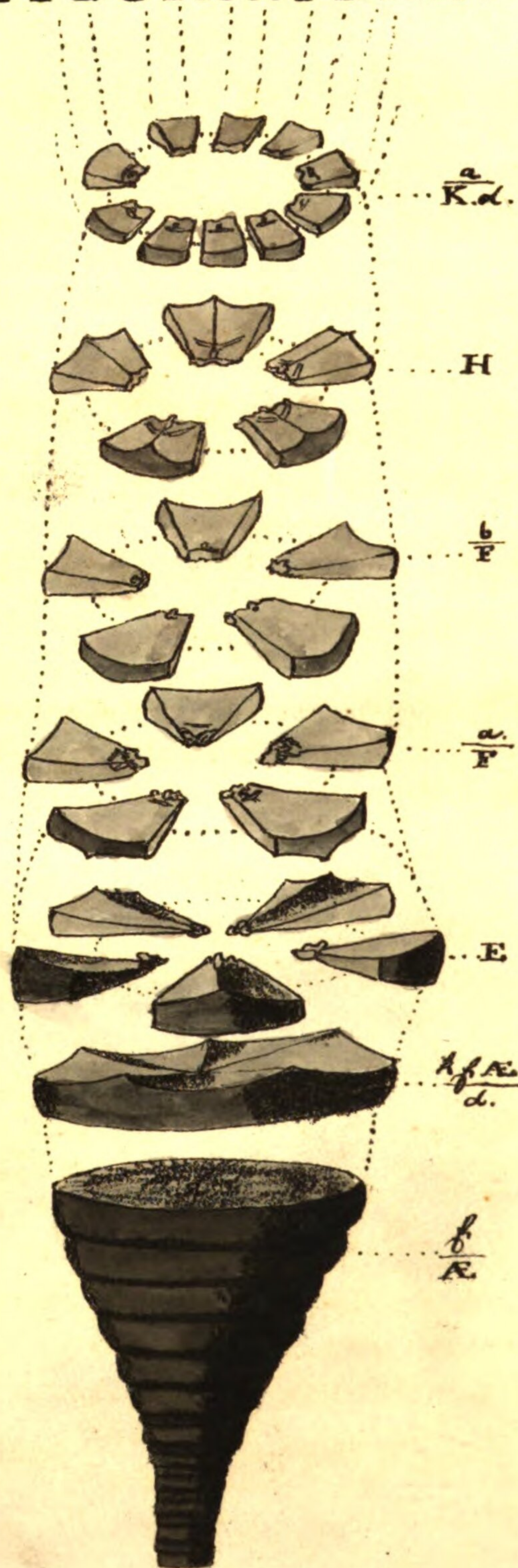
a Column enlarged at the summit.

o Alimentary canal round.

IX. GEN. EUGENIACRINITES.

1 *Sp. quinqu angularis.*

I. GENUS.
APIOCRINITES.



Miller del.

Observation.

The name of this genus is derived from the Greek *ammon*, pear.

None of its species have as yet occurred in a living state, and those found

fossil, are of local occurrence, and are of geological place to strata more recent than the lias.

I. Division.

One of the species is proved to be permanently adhering, whether the other

CRINOIDEA ARTICULATA.

I. SPECIES APIOCRINITES ROTUNDUS.

ROUND COLUMN-D-PEAR-LIKE LILY-SHAPED ANIMAL.

Character of the Division.

THE joints resting on the first, or superior columnar joint, and forming the cup containing the viscera, articulate by liplike and transverse processes, having a minute perforation.

Observation.

The name of the division **ARTICULATA**, is used in allusion to the articulating insertion of the joints forming the cup containing the viscera.

I. GENUS APIOCRINITES.**PEAR-LIKE LILY-SHAPED ANIMAL.***Generic Character.*

An animal with a column gradually enlarging at the apex, composed of numerous joints, of which the superior is marked by five diverging ridges dividing the surface into as many equal portions, sustaining the pelvis, formed of five sub-cuneiform joints, supporting others of a figure nearly similar, from which proceed the arms and tentaculated fingers formed of simple joints, having the figure of a horse shoe.

Observation.

The name of this genus is derived from the Greek *ἄπιον*, pear.

None of its species have as yet occurred in a living state, and those found fossil, are of local occurrence, and confined as to geological place to strata more recent than the lias.

One of the species is proved to be permanently adhering, whether the other was so has not been ascertained.

I. SPECIES APIOCRINITES ROTUNDUS.

ROUND COLUMN'D PEAR-LIKE LILY-SHAPED ANIMAL.

Specific Character.

A Crinoidal animal, with a round column composed of joints adhering by radiating surfaces, of which from ten to fourteen gradually enlarge at its apex, sustaining the pelvis, costæ, and scapulæ, from which the arms and tentaculated fingers proceed.

Base formed by exuding calcareous matter, which indurates in laminæ, and permanently attaches the animal to extraneous bodies.

Reference and Synonymes.

JOHN WALCOTT.—Description of the fossils near Bath, fig. 61. p. 46.

JAMES PARKINSON.—Organic remains, vol. 2. Bradford Pear Encrinite, T. XVI. fig. 1. and 14.

HÆFER, junior.—In Acta Helvetica, vol. IV. tab. 8. fig. 6. and 7.

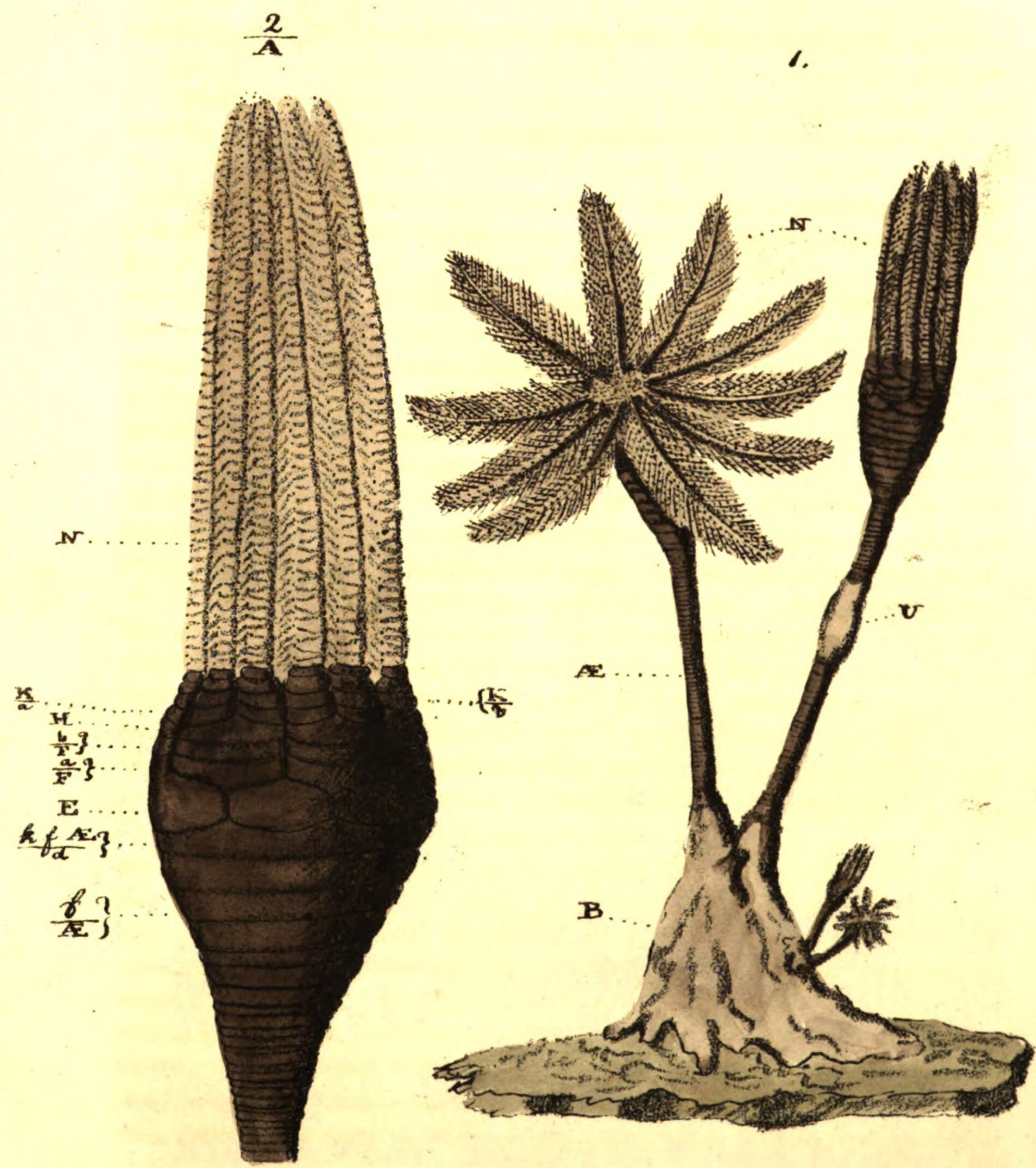
TOWNSEND.—Character of Moses, vol. I. p. 268. PL. XI. fig. 6. and 15.

Locality.

Bradford in Wiltshire, Abbotsbury near Weymouth, Dorsetshire; and Soissons.

APIOCRINITES

ROTUNDUS



Miller. del.

Description.

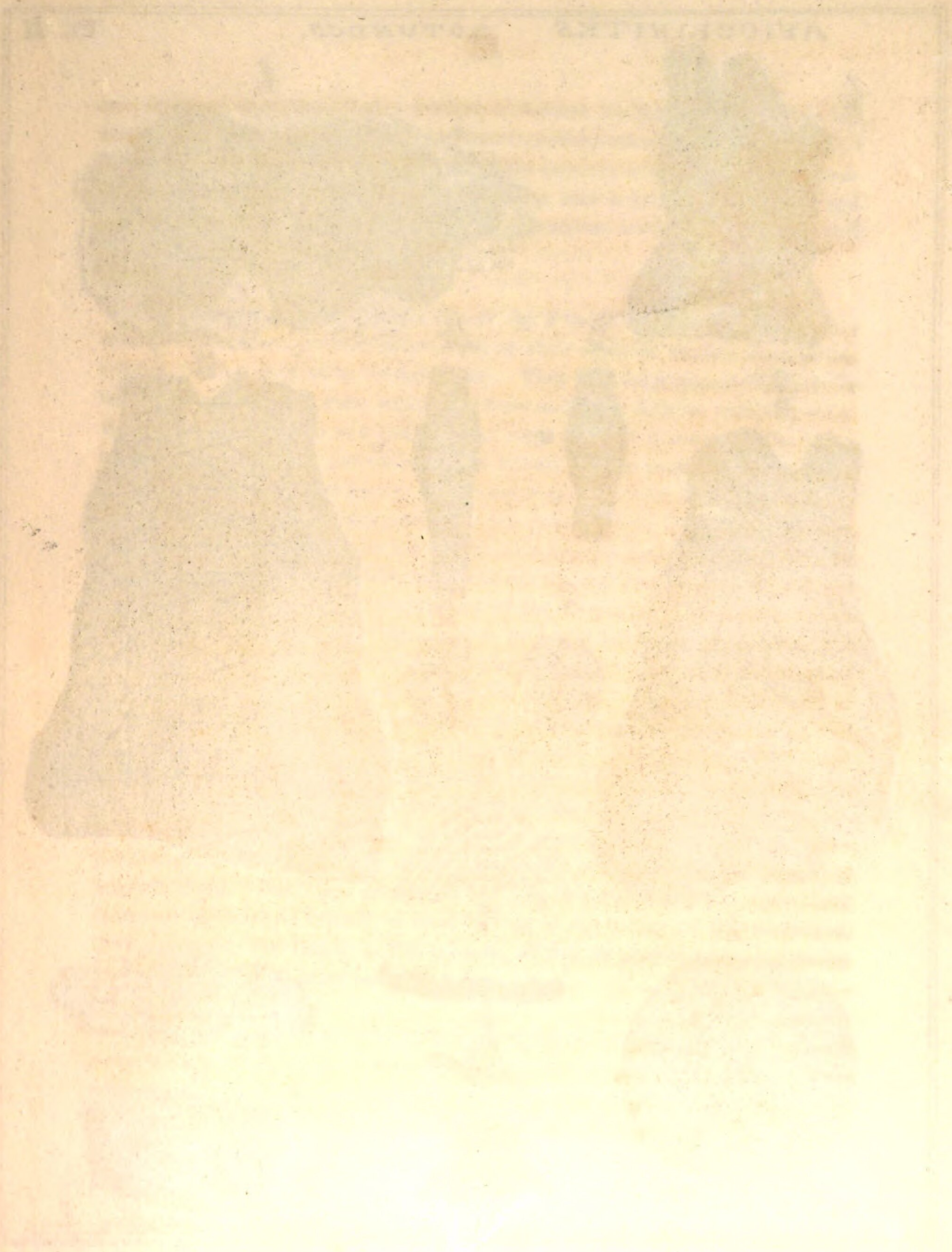
I have derived the specific name **ROTUNDUS**, from the animal having a round column.

The remains of the **APIOCRINITES ROTUNDUS** have as yet only occurred in a fossil state, and no perfect specimen has been met with. At Bradford the almost shapeless bases (PL. II. fig. 1. and 9.) of this species are met with, adhering to the surface of the oolitic rock, of various sizes, inclosing portions of the column, which are seen externally shooting forth from them. They are affixed in great number to each other, and not unfrequently to testacea and other extraneous marine bodies, which proves that the animal lived in the sea, and affixed itself wherever chance directed its ovum. Portions of the column (PL. IV. fig. 1.) the animal's superior pear-shaped part (PL. I. fig. 2.) and the separate joints of both are generally found in the clay which covers the oolite. As celleepores shells and serpulæ (PL. II. fig. 9) adhere to them, they must have been of a firm texture, and as these frequently occupy the inner surfaces of joints (PL. II. fig. 1) the remains of these animals must have lain for some time in a dead and separated state, before they were covered with the mass of the stratum in which they are imbedded. The comparatively rare occurrence of portions of the column, its short fragments, on which I never could trace the slightest mark indicating side arms, and the bulky superior part, point out that the column at no time could have been very long (PL. I. fig. 1.) since otherwise the animal would have been continually in danger of mutilation from the over poisoning weight of its superior part; and the more so as from its want of side arms it could have possessed no lateral support to counteract this weight.

The **COLUMN**, as has been observed, is formed of numerous round depressed joints (PL. IV. fig. 1 and 6) pierced in the centre to afford a passage to the alimentary canal (PL. IV. fig. 20.—PL. III. fig. 4.) Their upper and lower surfaces are striated in radii, of which the depressed spaces admit the elevated ones of the next joint. The radii are at certain distances interrupted by concentric of (more or less) elevated rings, parallel to the circumference of the column, which are more conspicuous towards its apex. (PL. IV. fig. 8, 9, and 14.) At each of these interruptions the radii divide (forming sometimes minute tubercles) thus increasing their number as the animal grows. This increase of the number of

ridges and furrows which form new points of articulation or insertion in proportion as the area of the joint itself expands, always insured an equal firmness of adhesion, for had the number of radii contained within the first narrow circle continued without dividing as they passed through those successively formed beyond it, being thinly scattered over a surface so much wider, they would scarcely have been adequate to this purpose.

The nearly flat joints in the enlarged part of the column (PL. IV. fig. 7. to 11) have on each side, near the centre, a concave depression, through which the alimentary canal passes. To this a sphincter like muscle (PL. IV. fig. 21.) was probably affixed, sending off short fibres to the joint above, to aid longitudinal action, and also radiating laterally, so as to spread in a thin membrane over the space between the columnar joints attaching itself to their radii, and more firmly adhering to the circular rings where these divide, and ultimately perhaps connecting itself with the muscular membrane that covers the joints externally. The sphincter seems to have been incapable of close contraction, whereby it would have interfered with the free passage of the alimentary canal, but its partial action on the radiating portion pulled downwards, or rather more closely together the joints on one side, whilst its passive relaxation suffered the other to rise, thus bending the column in various directions. The partial contraction of the sphincter muscle between each two joints, together with the longitudinal fibres, transmitted from one sphincter to the next, and thus proceeding through the interior of the whole column, formed a series of imperfect balls or cones, distantly analogous to those gelatinous ones between the vertebræ of fish, and not improbably here also tending to aid motion. Minute vessels appear to have carried nourishment from the alimentary canal to the periosteum, or the investing membrane, which, by secreting calcareous matter, formed the various joints. The growth or increase of these was effected by the continual application of fresh laminae, as is demonstrated by the rings noticed above intersecting the radiating striæ, which may be also traced through the interior by lines of a different colour, on forming transverse or longitudinal sections. (PL. III. fig. 3.) They are fewer in small specimens, and more numerous in large ones, resembling thus the rings which distinguish the growth of trees. That the power of increase was nearly the same in all the animals of this species of *Apiocrinites*, may be proved from a section showing 3 or 4 rings, since these will occupy exactly the same space in the centre of one showing



APIOCRINITES

ROTUNDUS.

PL. II

$\frac{7}{B}$



$\frac{8}{B}$



$\frac{9}{B}$



$\frac{11}{A}$



$\frac{12}{A}$



$\frac{10}{B}$



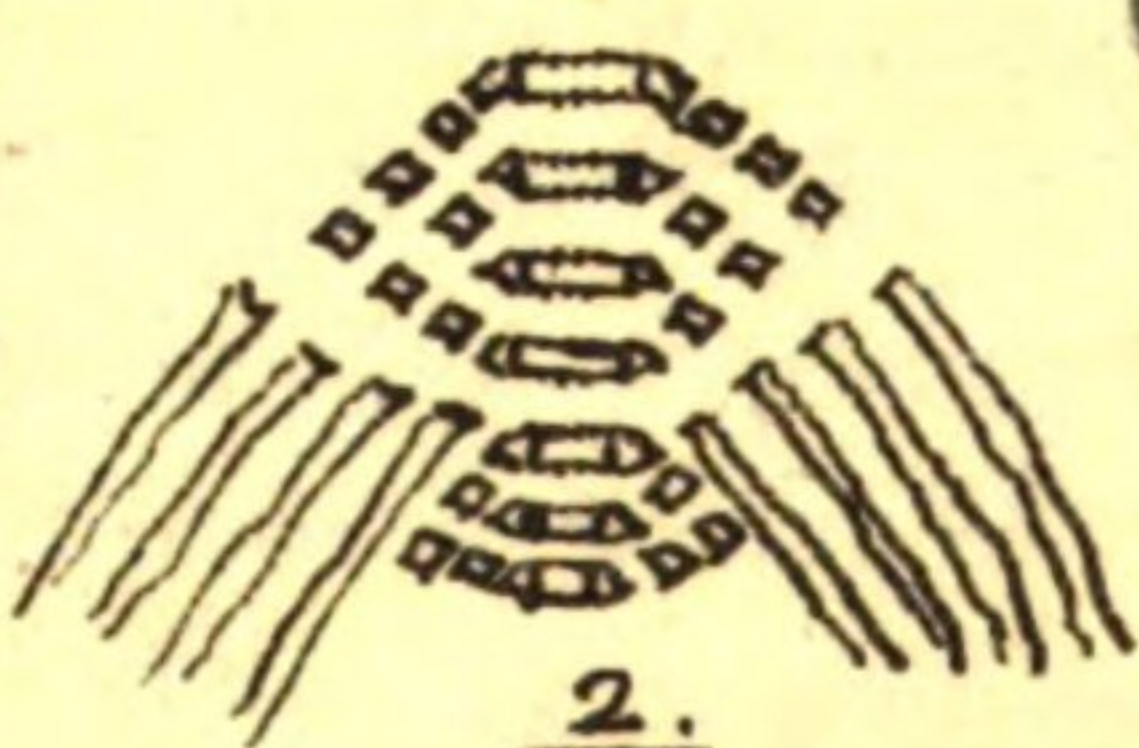
$\frac{13}{A}$



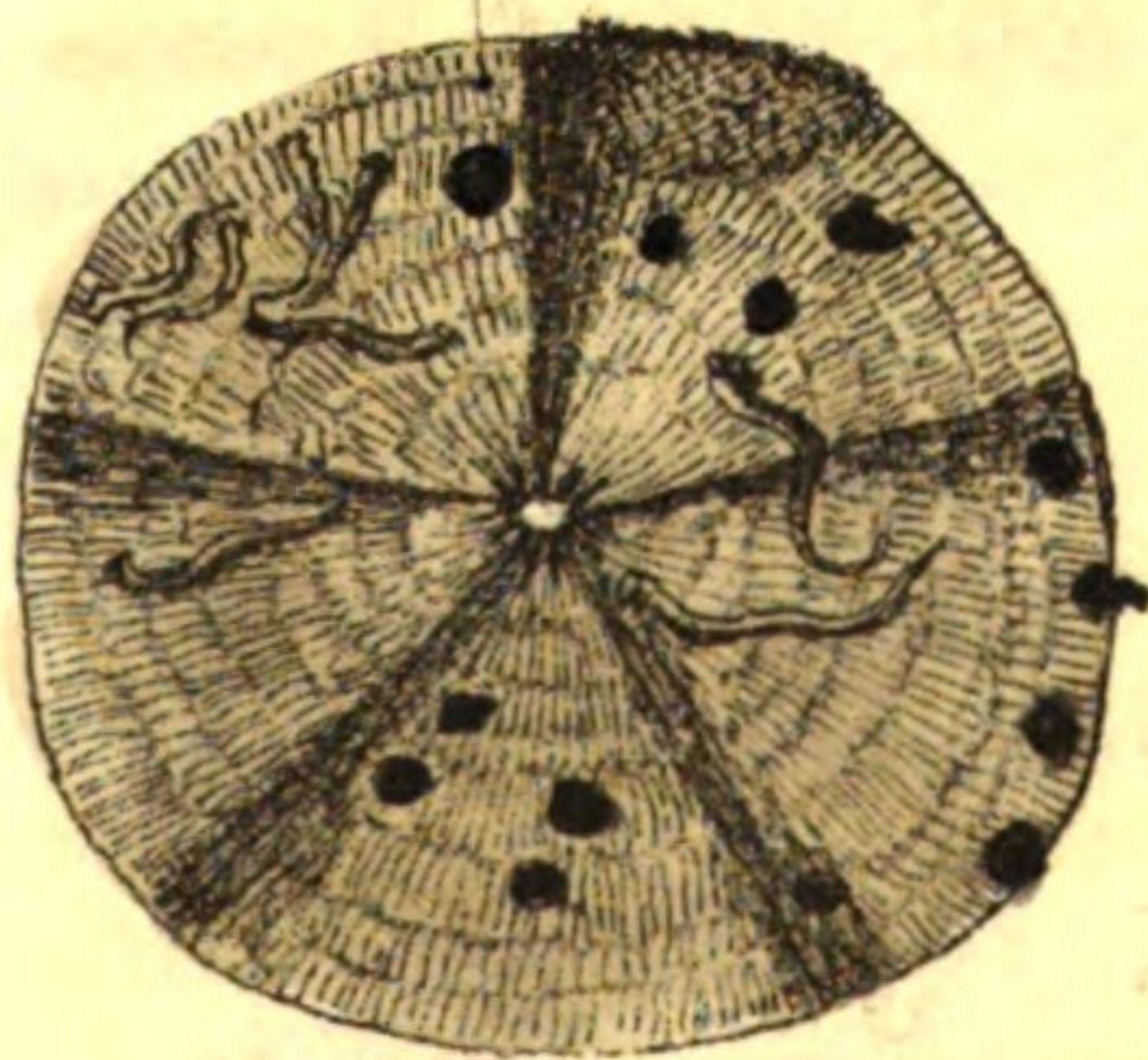
$\frac{14}{A}$



$\frac{15}{B}$



$\frac{1}{B}$



$\frac{2}{B}$



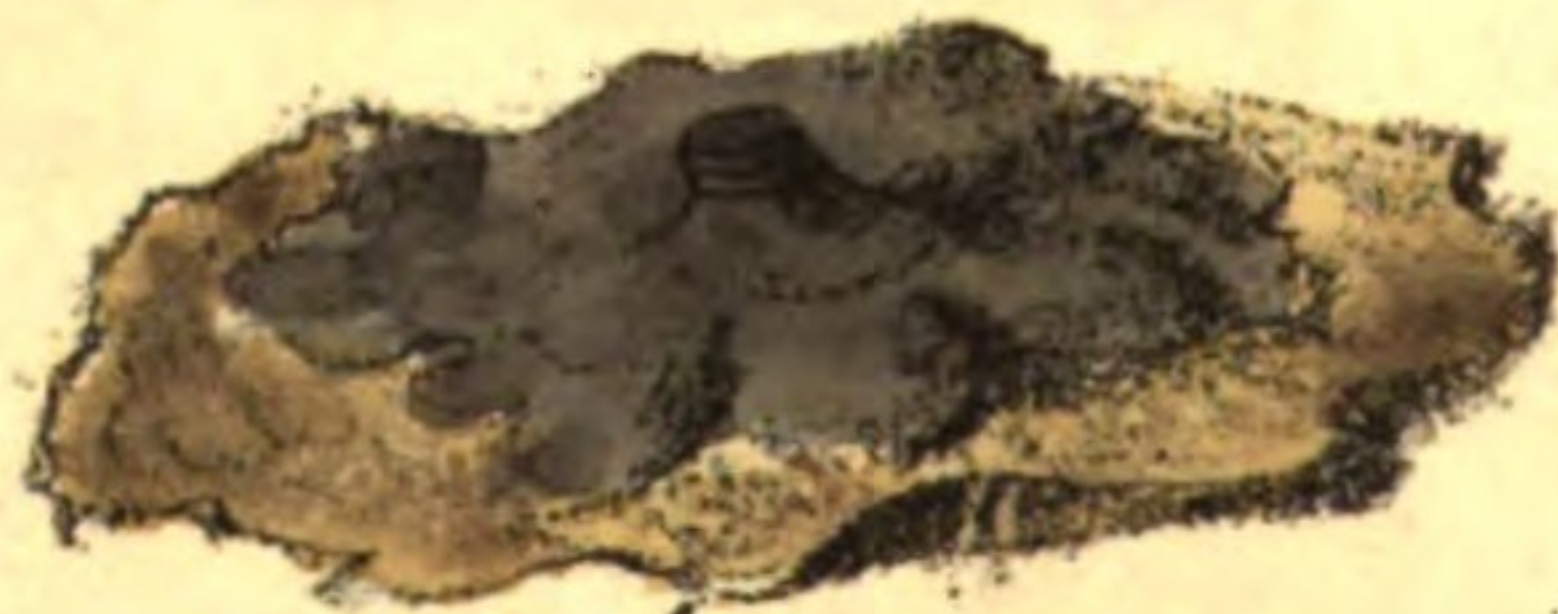
$\frac{3}{B}$



$\frac{4}{B}$



$\frac{5}{B}$



$\frac{6}{B}$



Miller del.

ten rings. I apprehend that a portion of animal matter remains always between the newly-formed ring and the former, perhaps interlacing with the radiating muscle where it divides. A proof of this appears to be, that when decomposition affects specimens, and converts them into a sort of ochre, the rings will separate, which could not happen, did not animal matter remain interposed from their original formation.

The enlarged columnar joints (PL. IV. fig. 8 to 12) are considerably thicker than the others, are concave below, and at their superior surface more or less convex, with a depression in the centre. They become gradually thinner towards the middle, and show more numerous and more delicate radiating striæ, their points of division and the elevated rings are very distinct; at the latter, sometimes a series of minute tubercles occur, where probably the covering periosteum adhered more firmly. In consequence of the concavity of the inferior surface having a greater curvature than the convexity of the superior surface, each joint is thinnest towards the centre, and hence a hollow lenticular space of a concavo-convex figure is formed between the two contiguous joints, which may be considered as an enlargement of the alimentary canal. The joints adhere by the last-formed rings, which probably afford a firmer connexion from their being less calcareous, and are kept together more firmly by the thin exterior muscle interlacing with the radiating ones. Their circumference is somewhat less below, and contracts a little at the superior and lower surfaces. Near the point of junction of the enlarged and unenlarged portion of the column, an alternation of thicker with thinner joints, may very generally be observed (T. I. fig. 2). This is common to all the Crinoidea, and has been explained as a provision of nature, to allow a greater power of motion to the portion of the column where it approaches to the parts destined to procure the animal's food. But I am convinced that this was also the place where new joints are continually formed, at least as long as the energy of life permitted, thus increasing the length of the column, as will be proved when describing *PENTACRINUS CAPUT MEDUSÆ*.

The column at its lower extremity is more or less surrounded by calcareous matter of laminar construction, thereby adhering to extraneous substances; this has been called by Mr. PARKINSON the PEDICLE OR BASE. (PL. II. fig. 1. to 10). I have been fortunate enough to acquire a series of specimens

of this part from its earliest and youngest form, when it possessed a width and elevation not exceeding one-fourth of a line, to its mature growth, and the size of some inches. The very minute bases above mentioned,* adhere to a superior columnar joint (T. II. fig. 1.) and possess in the centre a very minute column surrounded by laminæ which form a small regular cone. These, in combination with numerous other specimens in different stages of growth, and with their longitudinal sections, prove that the exuded calcareous matter forming the pedicle or base, became completely indurated soon after its deposition, since the lowest columnar joints to be traced at the bottom of the base are very minute, (Pl. II. fig. 3. and 4.) not exceeding the proportions of the youngest specimens, (and must therefore have been prevented from increasing and expanding in their growth by the unyielding nature of materials surrounding them) whilst the succeeding joints become in series at certain intervals of four, five, or even more, successively larger and larger. It may also be seen that the inferior portions of the alimentary canal enveloped in the base, become gradually filled up and obliterated, being no longer required in this part of the animal (T. II. fig. 4. and 10.) where all increase had long ceased.

The secretions of the indurating calcareous matter took place in considerable quantity when the animal grew up, and appears to have flowed abundantly from vessels between the radiating surface of two joints. This is beautifully displayed in sections of large bases (T. II. fig. 10.) where the differently coloured laminæ demonstrate the gradual formation of this part, their lines and the manner in which they spread over and encompass extraneous matter which happened to be in their way, proving the original fluidity, or rather viscosity of the mass.

These lines prove also decidedly that the irregular conical mass of the base is made up of distinct laminæ, concentric and parallel to the outer surface of the cone, placed one within the other, and resulting from successive or periodical increase by deposition. In longitudinal sections, as we have already stated, these lines are decidedly seen, but lines of separation are also seen traversing

* These very minute bases are interesting, as affording a proof that the propagation of these animals must have been oviparous; since from their size they must have belonged to the very earliest and almost embryotic state of the animal; and yet are found affixed, not to the parent's body, but to a dead plate; whereas the offspring produced by gemmiferous generation, never becomes detached from the parent's body till it has obtained a considerable size.

at right angles those parallel to the general conical surface, and likewise originating from each joint. As therefore, the first lines of separation generate a conical surface pointing upwards, so this second set generate a conical surface pointing downwards, and thus truncate, or rather excavate, by cutting into them the apices of the first cones. When the base is in such a state that the laminæ of which it is formed are disposed to separate (PL. II. fig. 15.) its detached pieces, often present this excavated conical form, altogether resembling models of the crater of a volcano. These second lines of separation do not, however, extend to the exterior circumference of the base, except near its summit, but terminate in its interior, and are not all of equal lengths, but occur in sets, of which the lowest line is always longest, and those which succeed it, in proceeding upwards, gradually diminish for a series of from six to ten joints, until followed by the longest line of the set next above. Such are the appearances; the explanation I am inclined to offer of them is as follows. The muscular membranes which are interposed between the columnar joints, may very probably have carried on them the vessels whence the exudation of the calcareous matter forming the laminæ of the base proceeded; these membranes may have continued to extend themselves in the direction marked by these second lines. The original existence of such an interposed membrane will readily account for the separation which, as we have seen, still takes place in this direction, in many specimens. And as we have already seen reason to believe that the exudation of the calcareous matter did not proceed continuously, but was rapidly thrown out at certain periods; so we may suppose all the lines of a single set to have been formed by the extension of the membranes during one of these active periods, and their different lengths to indicate the size they had attained when that action ceased.

The quantity of matter accumulated round the base, indicates the degree of adhesion and support the animal required; and, perhaps, bears also proportion to the quantity of calcareous substance accumulated in the alimentary canal, and from which it became necessary to free it when inconvenient to its economy.

Portions of the column (PL. I. fig. 1. and PL. II. fig. 2. to 14.) are not unfrequently encompassed by a thick spreading ring of calcareous matter, in every particular resembling that which covers them at the base, and forms their

secure adhesion to extraneous bodies. We may thence conclude that here the office of this laminar ring-like concretion, was to repair an injury sustained by the column.

The SUPERIOR ENLARGED COLUMNAR JOINT (T. IV. fig. 13. and 19.) resembles in its inferior surface those preceding it, but as its centre commands the entrance to the alimentary canal, it is provided with a sphincter muscle capable of close contraction, as is proved by a specimen, perhaps unique, in my possession, (T. IV. fig. 13. to 15.) where the folds produced by the action of this muscle are distinctly seen. Its upper surface has five ridges diverging from the centre, the space between which is, more or less, concave. The circumference of the superior margin is still somewhat greater than that of the inferior, and the outer surface of the joint swells out in a trifling degree towards the middle, being slightly contracted towards either margin. Sometimes the upper surface of this joint is peculiarly convex (T. IV. fig. 16. and 18.) in which case, generally, both these margins appear much compressed; this is evidently a result of contraction, and an additional proof of the original unindurated state of the exterior part of the joint.

Before we proceed to examine in detail the separate pieces composing the body, and completing together with the upper enlarged columnar joints just described, the pyriform shape that characterises the superior portion of this animal, it will add much to the clearness of the ensuing description, to state in a concise manner, although at the expense of some repetition, the general form and relations of this part and its constituent members. (See the plate illustrating generic characters).

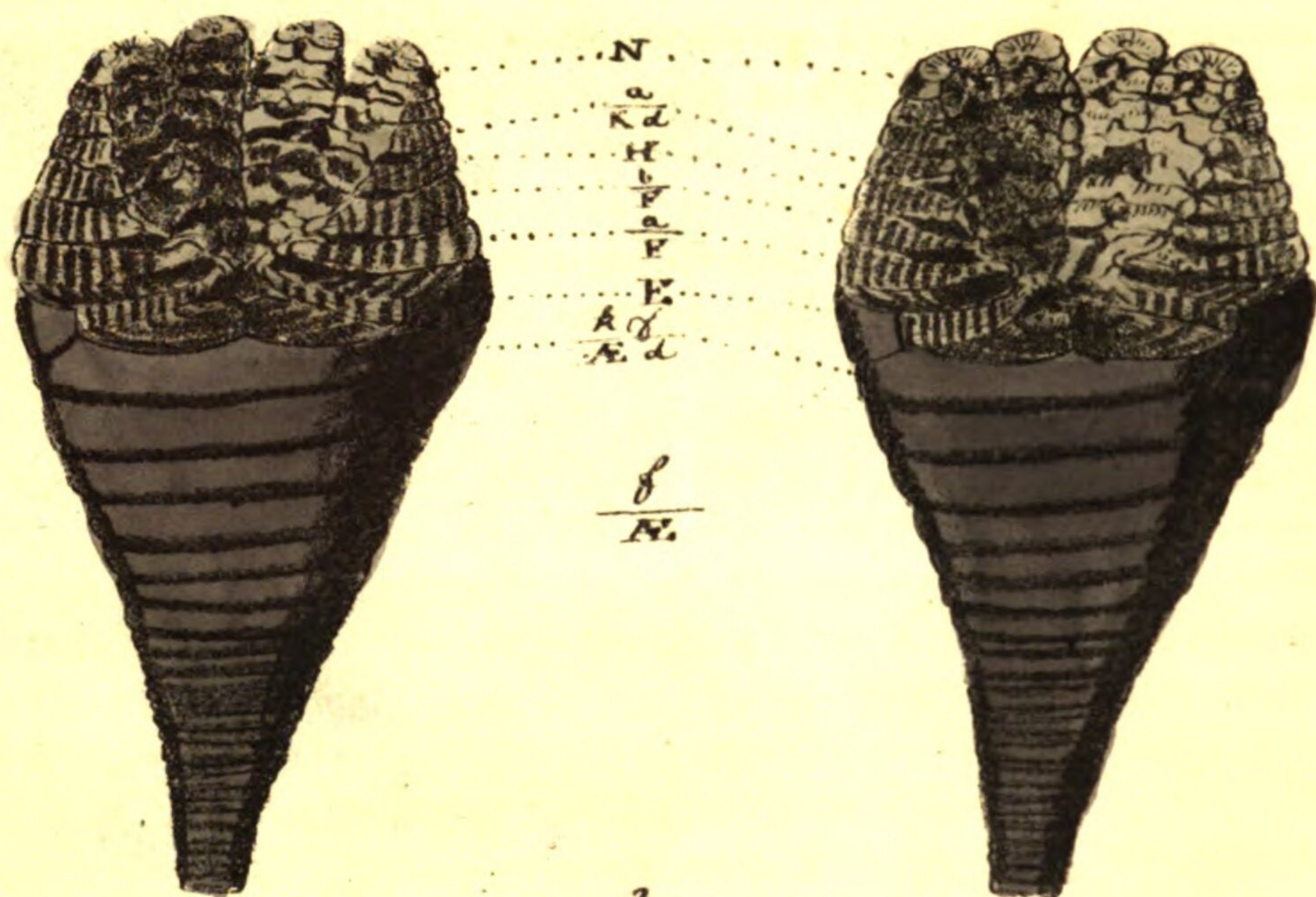
In each of the four rows which succeed the upper enlarged columnar joint, the circumference of the body becomes divided into five distinct and similar joints; which although necessarily undergoing much subordinate variation of figure, to fit them for their respective places and combinations, have yet many general points of analogy in all these rows. They all have a wedge-shaped, or rather truncated pyramidal form, being arranged round the central cavity of the body, like the blocks of masonry which compose the courses of a cupola, presenting their broader ends or bases towards the exterior circumference, their narrow end or truncated apex towards the interior. Hence, in describing these joints, we have always six surfaces to take into consideration; the EXTERIOR

APIOCRINITES ROTUNDUS.

PL. III.

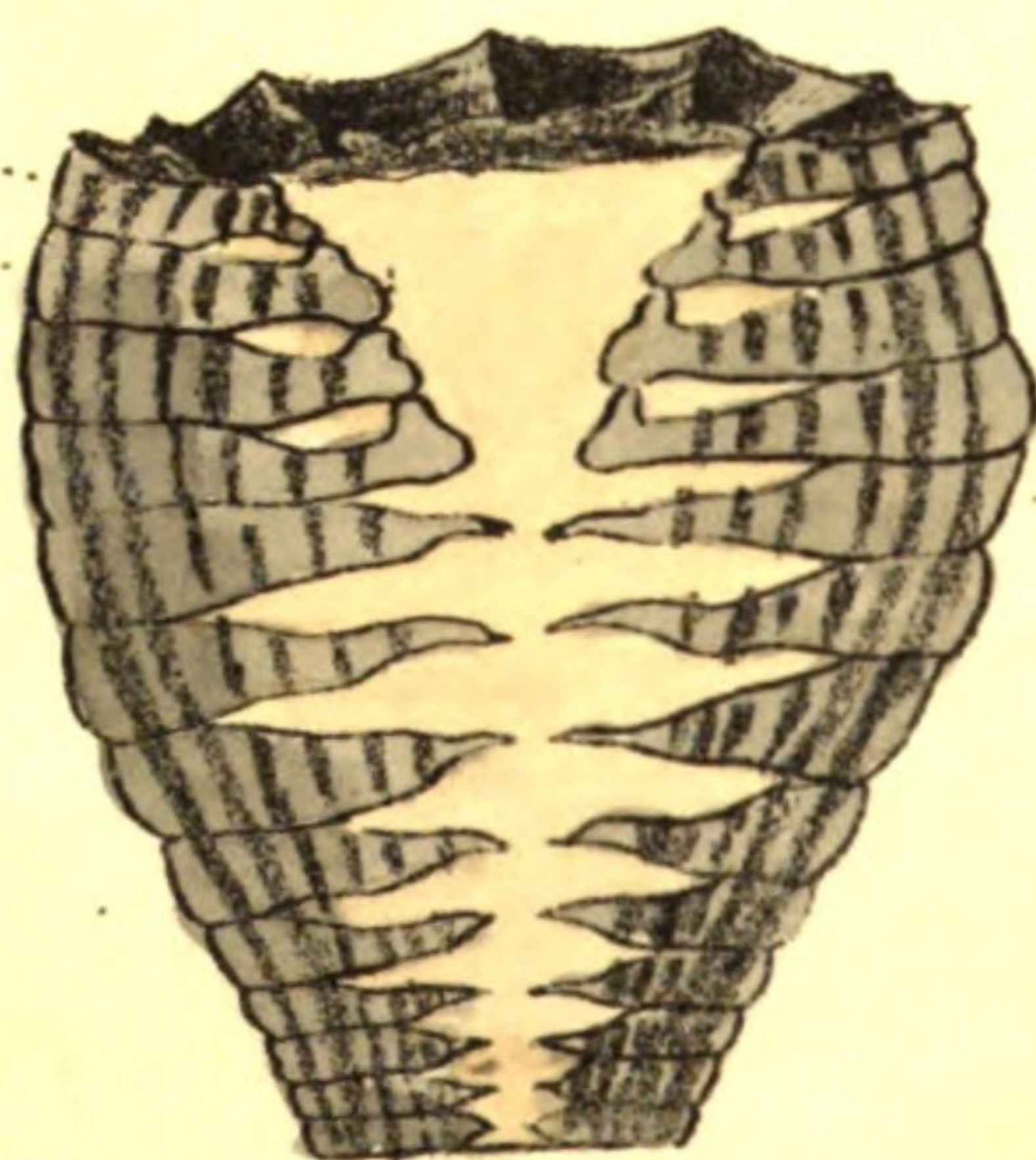
$\frac{1}{A}$

$\frac{2}{A}$

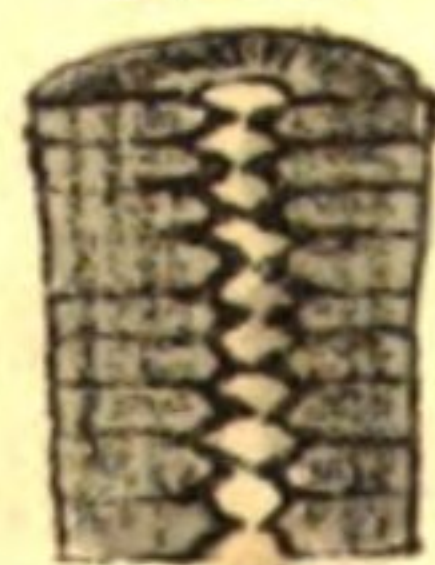


$\frac{3}{AE \square}$

H
b
f
a
F
E



$\frac{4}{AE \square}$



V

Miller del.

CIRCUMFERENCE, the INNER TRUNCATED EDGE, the UNDER SURFACE by which they rest on the row beneath them, the UPPER SURFACE which they present towards the row above them, and the two LATERAL SURFACES which they present to the contiguous joints of the same row. These terms will be henceforth used, without further definition, in describing each of these joints.

In each successive row, the inner surface recedes further and further from the centre of the body, and opens more and more widely the internal cavity which contained the mouth and viscera.

Each joint has near its inner edge various tubercular (sometimes TREFOIL SHAPED) PROCESSES, with perforations destined apparently for the insertion and conveyance of muscles and vessels, behind which there is either a remarkable SUBTRIANGULAR RIDGE across the upper or lower surface, or a tubercle with an elongated muscle. The outer surface is always plain; the upper, under, and lateral sides are always marked with radiating striæ, interrupted by transverse concentric ridges, in a manner exactly similar to those which have been already described in speaking of the columnar joint, and forming a continuation of the same system.

The joints of the first row, will, from the analogy of their places and offices, be termed the PELVIS; those of the second, the FIRST COSTAL; those of the third, the SECOND COSTAL; and those of the fourth, the SCAPULÆ.

Above the scapulæ a further subdivision of the circumference into ten distinct pieces takes place. The two first rows of this subdivided series may be considered as ARM JOINTS; the succeeding rows as FINGER JOINTS, which send off smaller jointed tentacula, one from every finger joint.

A correct representation of all these pieces, sufficiently detached to show their general form, but still arranged in their relative position, will be found in the plate illustrating the character of the genus; each piece will be seen separately figured in PLATES v. and vi. and external and internal views of the united body as composed of them, in PLATES i. and iii.

The PELVIS (PL. v. fig. 1. to 6. and 19.) is formed by five wedge-shaped or truncated pyramidal plates, each resting by its inferior surface, which is concave, upon one of the five concave spaces of the superior enlarged columnar

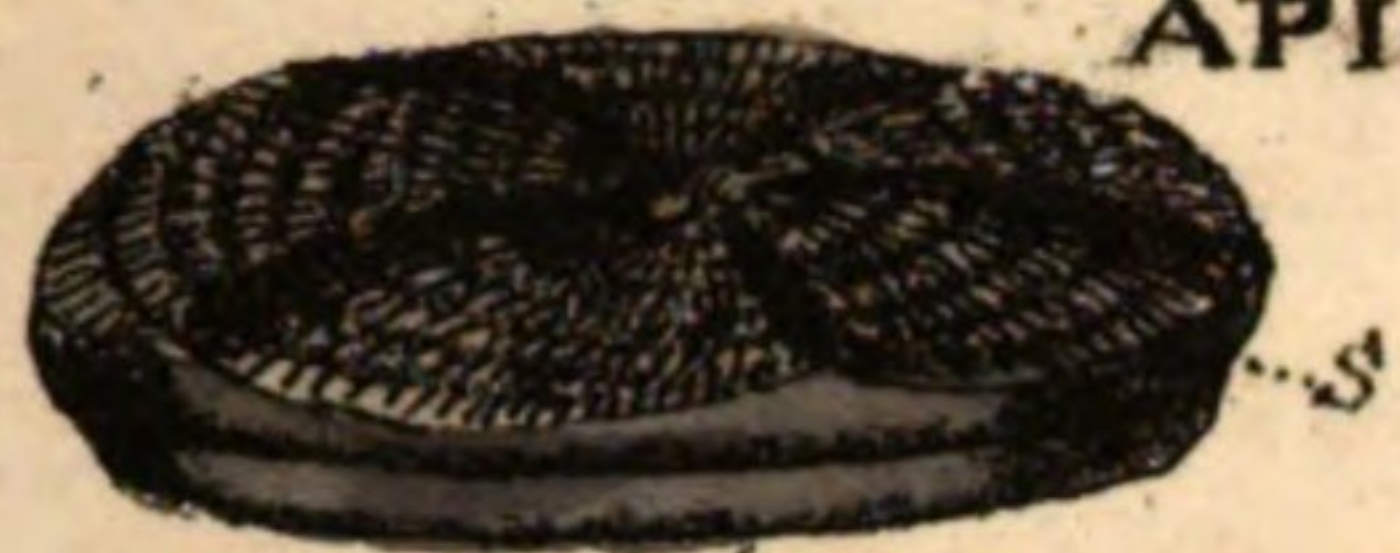
joint last described. They adhere by their lateral surfaces together, and the whole row forms thus a kind of basin, having a subpentangular aperture in the centre, arising from the truncated terminations of their inner edges. The superior surface of each has a ridge in the centre sloping towards the lateral surfaces, and thus, between every contiguous pair of joints, a depression is formed for the insertion of the first costal joints.

There generally exists at the lower surface (PL. v. fig. 2.) a small slightly-arched space, between the lateral surfaces, arising from their edges being bevelled, which was occupied by an intervening muscular organization, and may have facilitated a gradual sliding outwards of these joints, when the increase of the central aperture became necessary to the growth of the animal; and tended also to preserve a more free and easy motion of these parts. The exterior circumference of each plate is contracted towards the angles, and swells slightly to the middle. These joints become gradually thinner and narrower towards the truncated points, each of them having moderately thick trefoil-shaped elevations. The central leaf of this trefoil has a small tubercle on each side (PL. v. fig. 19 $\frac{3}{4}$.) which serves by its insertion into a small concavity of the first contiguous costal joint above, to aid its motion (PL. v. fig. 20 $\frac{3}{4}$.) to which also a nourishing vessel extends (PL. v. fig. 20 $\frac{3}{4}$.) from a perforation in each of the side leaves of the trefoil elevation on the pelvis. (PL. v. fig. 19 $\frac{3}{4}$).

THE FIRST COSTAL JOINTS (PL. v. fig. 7. to 12. 20. and 21.) nearly resemble those of the pelvis, and insert into the subconcave or subtriangular cavities formed by them, yet so as to leave in the interior an open space. They have also, like the former plates, an arched groove between their lateral surfaces, resulting from their bevelled edges.

Their inferior surface has an elevated ridge, their superior is concave. Their exterior circumference is smallest at the upper part, and they do not extend so far in the interior as the plates of the pelvis. The truncated point is somewhat excavated (PL. v. fig. 21.) and slopes off gradually towards the upper and under surface, having beneath a lip-like process (PL. v. fig. 20.) over which the depressing muscle slides, which is affixed to two side elevations of the two contiguous joints of the pelvis, and divides as it proceeds (PL. v. fig. 15. and 16.) leaving a swelling in the centre to attach to a lip-like prominence on the upper margin. At the lower surface, behind the lip-like process, on each side of the dividing ridge, is a protuberance (PL. v. fig. 20 $\frac{3}{4}$.) perforated

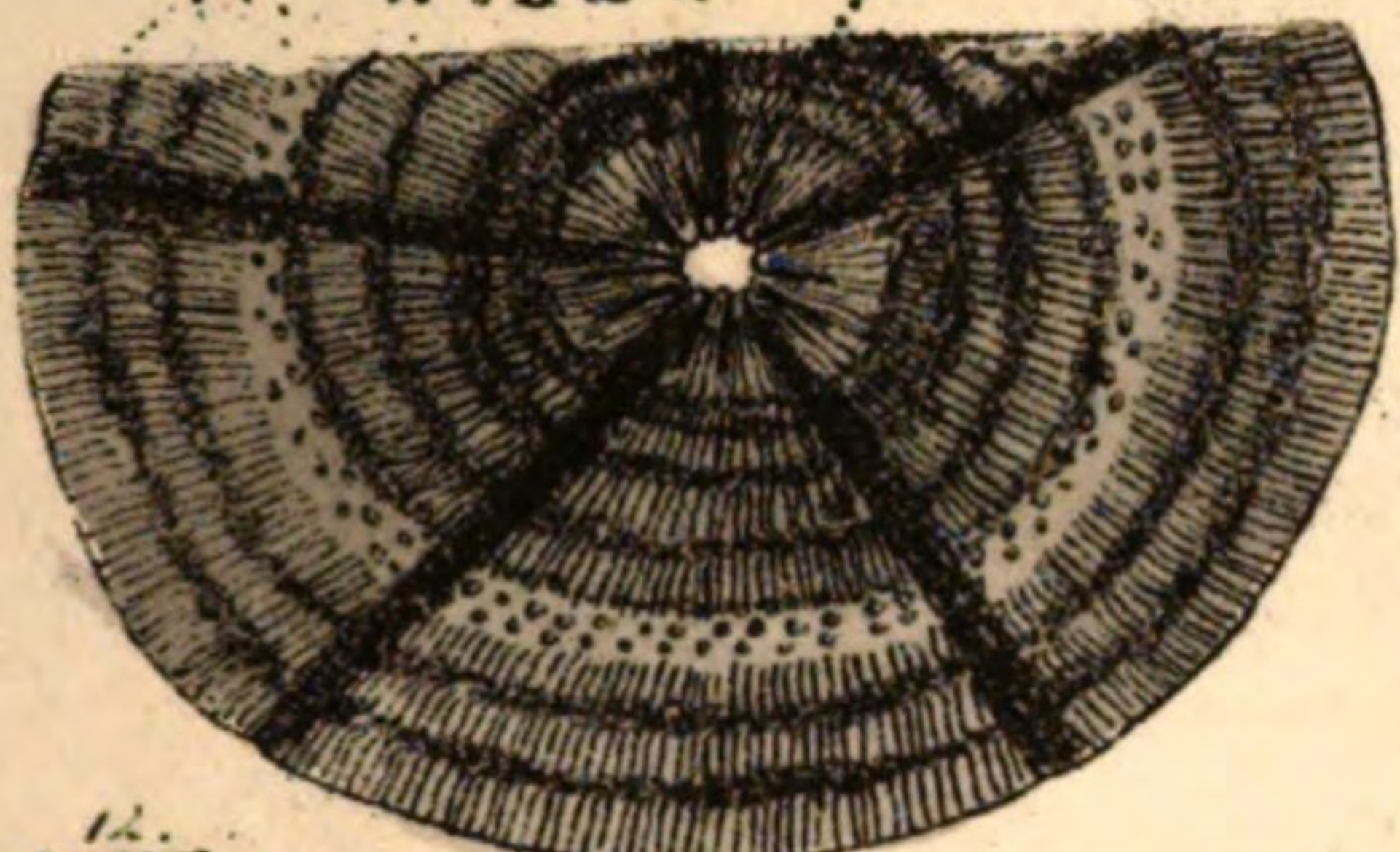
18
RÆd



16
RÆd o



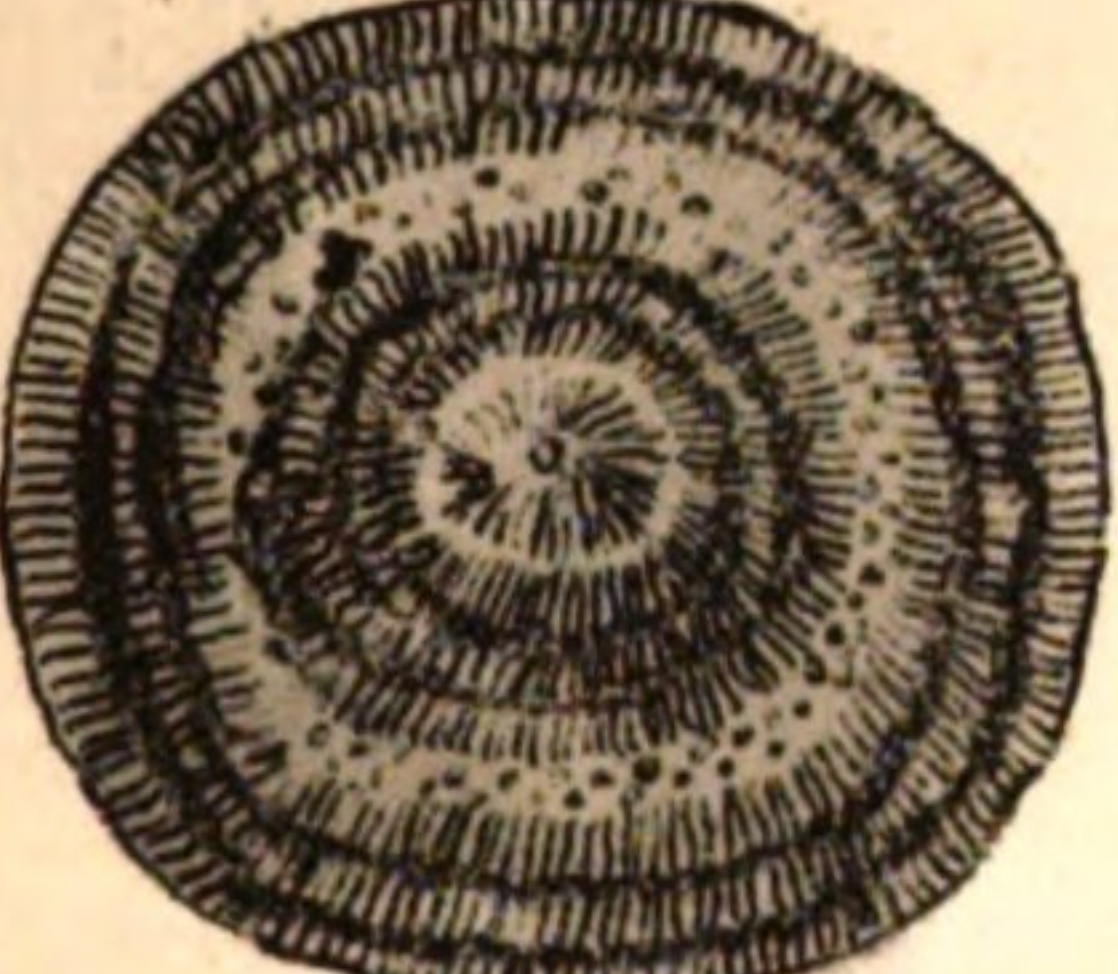
14
RÆd l



12
fÆd o



9
fÆd k



5
Æd k



4
Æd =



20
Æd x



h

APIOCRINITES ROTUNDUS

PL. IV.

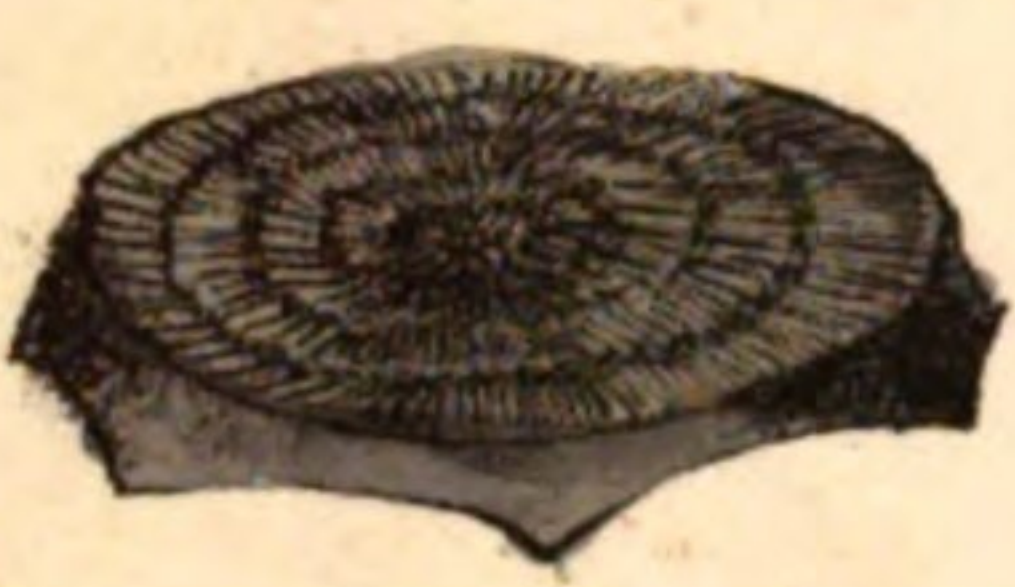
19
RÆd



17
RÆd o



15
RÆd l



10
fÆd



7
fÆd



fÆ...

11
fÆd o



8
RÆd l



3
Æd l



6
Æd o

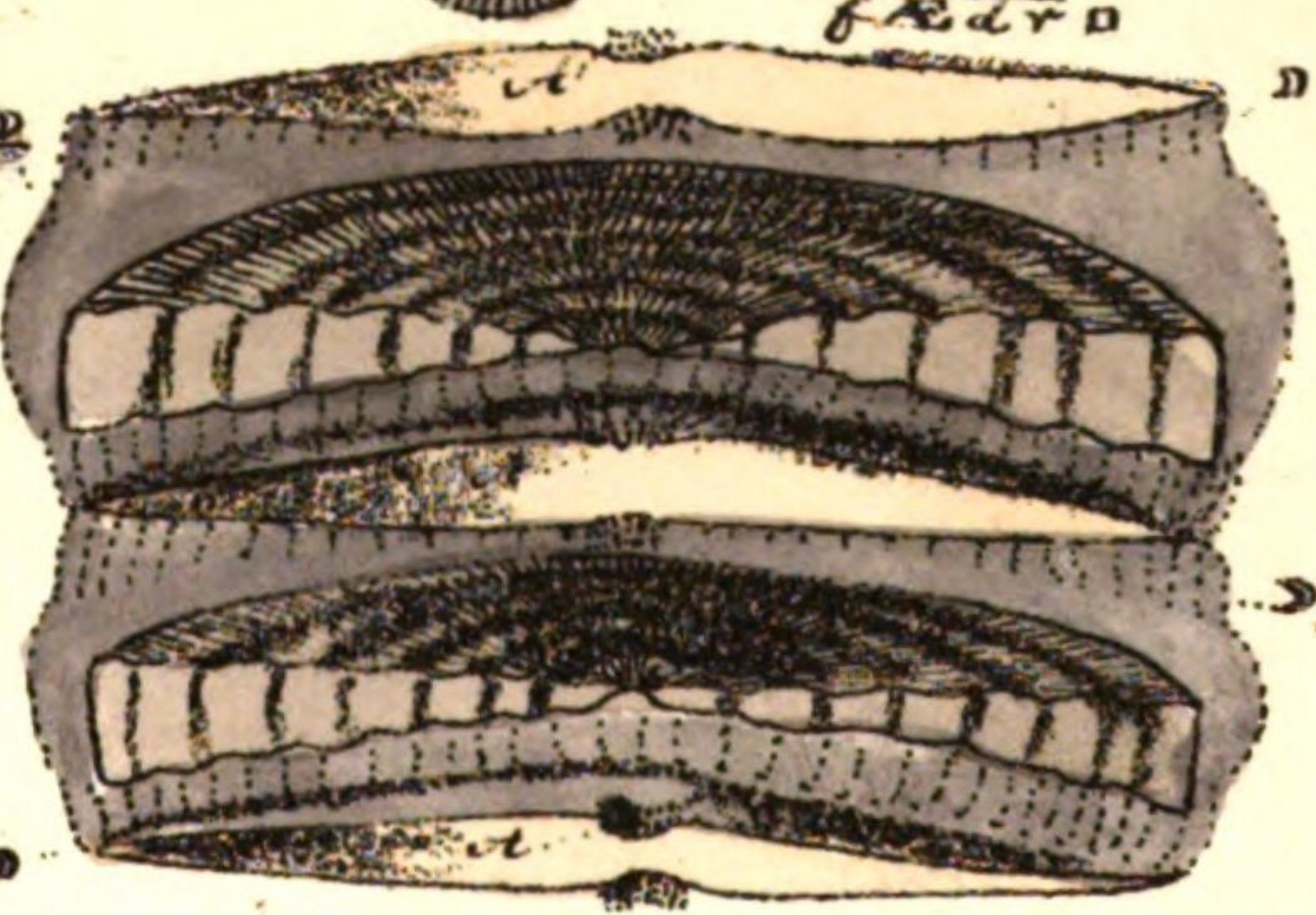


21
fÆd r o

2
Æd



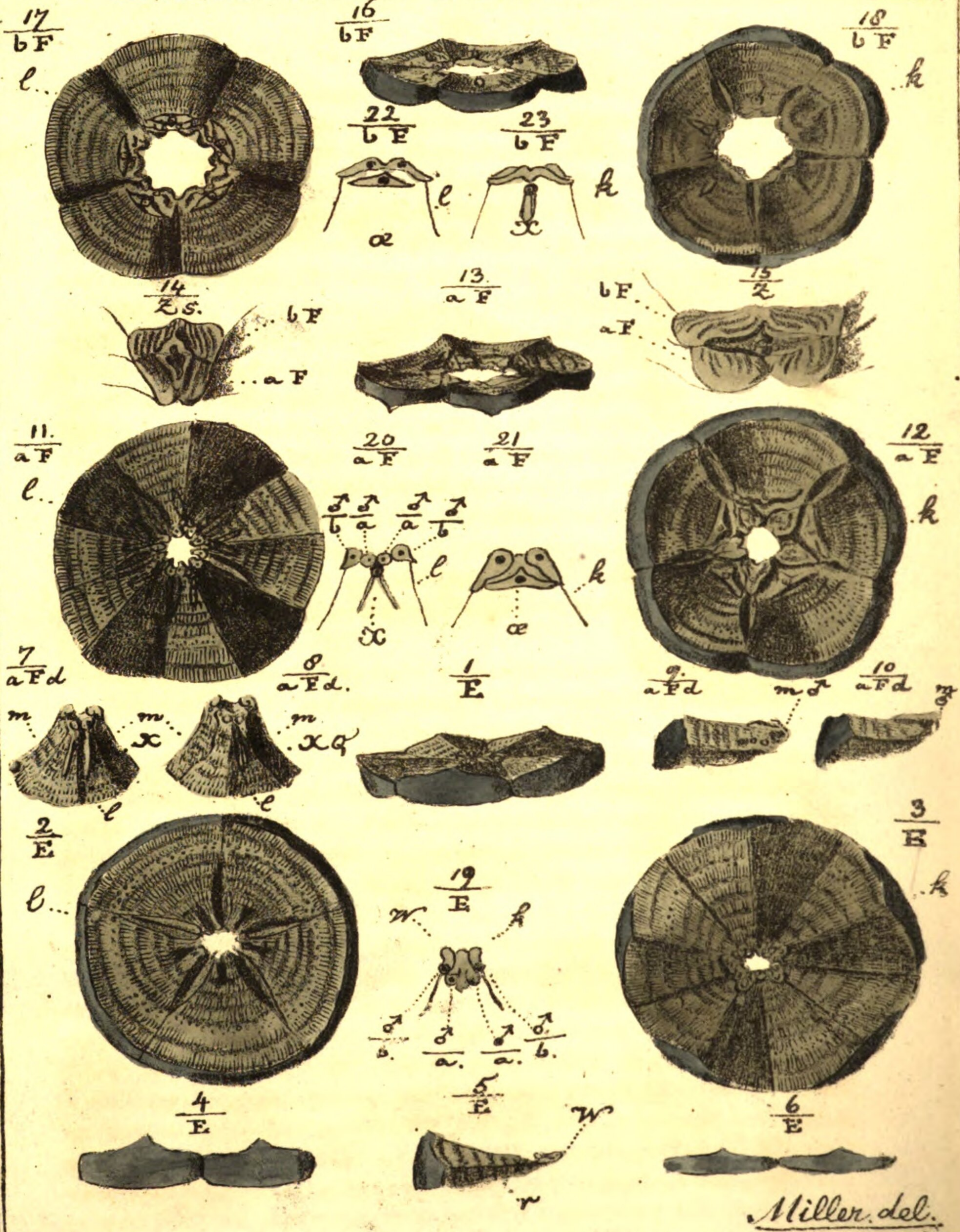
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Æ



Moller del.

APIOCRINITES ROTUNDUS.

PL.V.



in the centre, to admit a nourishing vessel and muscle, arising from the side elevation on the central leaf of the trefoil-shaped swelling, on the inner margin of the pelvis. Between these protuberances and the dividing ridge, on each side extends a branch of the depressing muscle over the radiating surface to the exterior margin. (PL. v. fig. 7. and 20. x.) In a specimen in my possession (PL. v. fig. 8.) one part of this muscle has slid over the ridge, and its two branches lie united together. At the upper surface (PL. v. fig. 12. and 21.) the lip-like prominence extends laterally in such a manner as to present the appearance of cordate petals, when the five joints are arranged in their natural circular position. In the centre, between each two, is a very small elevation inserting in a groove on the second costal joint, having behind it an oblong irregular triangular ridge (PL. v. fig. 21. æ.) with a perforated centre, containing a muscle and vessel of nourishment formed by the union of those in the two perforations noticed on the inferior side of this joint. (PL. v. fig. 20. §.) The short angle of the ridge extends to the lip-like process, and serves for the attachment of an elevating muscle, which is to counteract the depressing one noticed before; the effects of their operations may be frequently seen in the numerous rugæ they formed across the truncated point.

On each of the two lateral surfaces by which the first costals adhere to each other, is a curved continuation of the lip-like process, (PL. v. fig. 9. and 10.) in whose centre we notice a perforated concave tubercle, which furnishes the idea that here, perhaps, a mechanism existed to aid motion, on the principle of a ball of fluid enclosed in the concavities of two approximating tubercles; analogous to the intervertebral structure of fish. Sometimes a few smaller unperforated tubercles continue the curved direction of the lip-like process, all probably serving for firmer muscular adhesion.

The SECOND COSTAL JOINTS (PL. v. fig. 14. to 18.) bear also an affinity in their general formation to the former, the larger inferior surface rests on the former joints, whilst a similar superior one admits the scapula. The inferior surface is convex, the superior concave, the lateral sides are bevelled, forming spaces like those noticed when speaking of the first costal joints. Their exterior circumference contracts above, and their interior withdraws still further from the centre, thus enlarging the opening which now assumes the form of a funnel shaped cavity (PL. III. fig. 1.) The inner or truncated edge has below, near the margin, a lip-like process cut out in the middle of its inferior surface, and presenting a reflected curve, by which the joint rests on

the lip-like ridge of the former. Behind this, is again as on the superior surface of the first costal joint, a transverse subtriangular ridge (PL. v. fig. 22. α .) with its perforation, to which the depressing muscle of the lip of the second costal joint is attached. Near the margin of the superior surface is an elevated rim, having rounded corners, and an angular depression in the centre, behind which is a perforated tubercle, and a muscle analogous to that on the lower surface of the first costals.

The **SCAPULÆ** (PL. VI. fig. 1. to 5.) contract so much at their upper circumference, as to complete, in conjunction with the two following joints, the pyriform shape of the superior part of this species of *Apiocrinites*. At the inferior surface they are convex, and have at the truncated or inner end a perforated tubercle behind the margin, with a muscular elongation, similar to that on the superior part of the second costal joint. The superior surface has an elevated ridge, forming on either side two concavities for the insertion of the two first arm joints. At the truncated end a lip-like process exists, behind which is situated a trefoil-shaped elevation of a more extended, but somewhat similar, figure to that before noticed in the pelvis, with two perforated lateral tubercles.

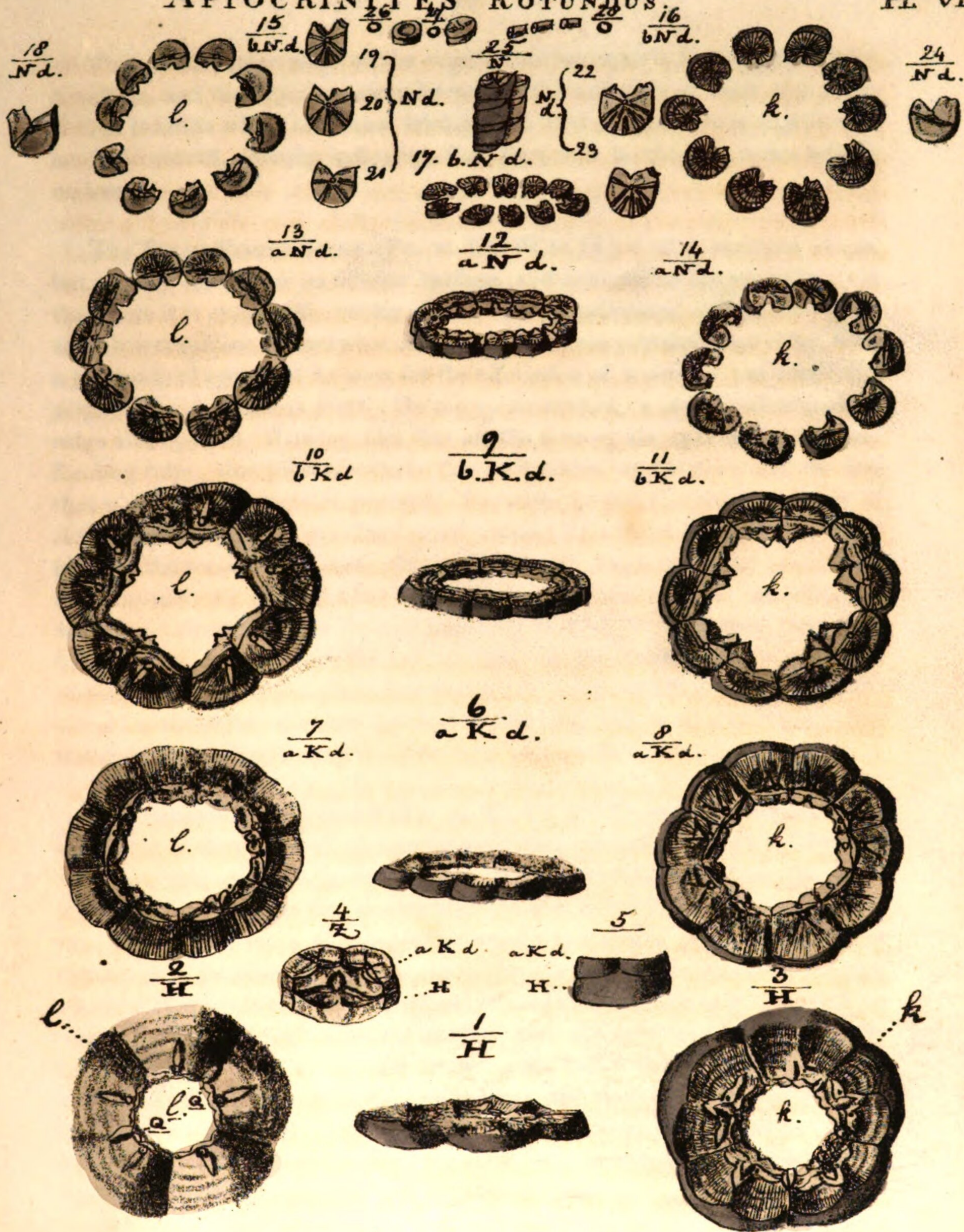
With the scapulæ the division of the circular area of this part of the animal into five joints ceases, and another of ten commences, which gives rise to that number of arms and fingers.

The **FIRST ARM JOINT** (PL. VI. fig. 6. to 7.) resembles in every particular the second costal joint, only that it is considerably smaller and thicker in proportion, and that the perforated tubercle stands somewhat more towards the side, which comes in contact with the fellow arm joint belonging to the same scapula. This evidently results from an impeded increase, arising from want of room for extension in that direction, and from the lateral power exerted by the muscle proceeding through the perforation from the lower surface of the scapula, where it begins to divide.

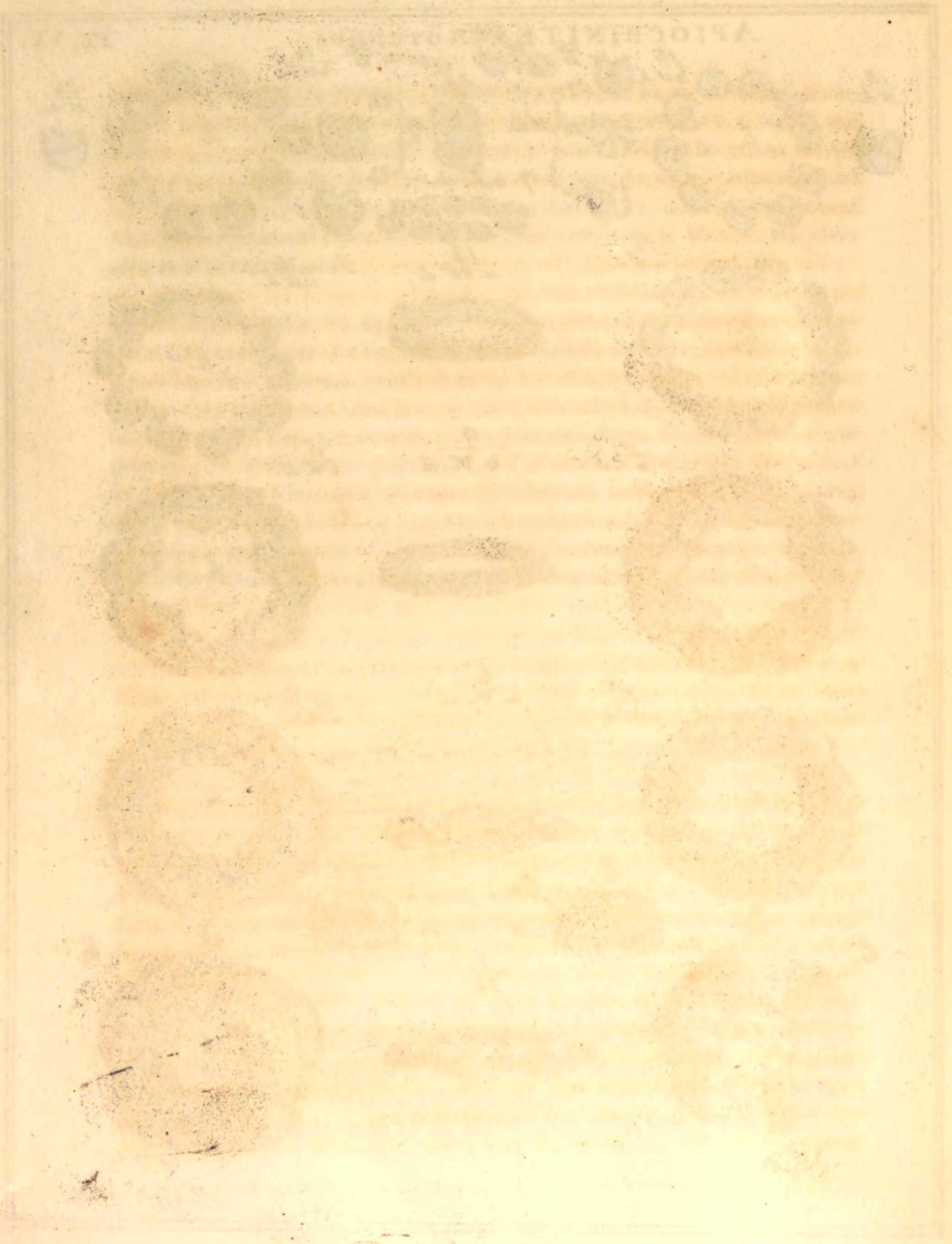
The **SECOND ARM JOINT**. (PL. VI. fig. 9. to 11.) As the first arm joint was observed to resemble the second costal joint, so the second arm joint will be found somewhat analogous to the first costal; excepting that it wants the lower central ridge, that it is thicker, and like the joint on which it rests, abbreviated on the inner side, next to its fellow in the series arising from the same scapula.

APIOCRINITES ROTUNDUS

PL VI.



Miller del.



The subtriangular ridge on the superior surface stands in a more slanting direction, and the superior circumference on the outside of each arm joint, or that towards which the series arising from two scapulæ come together, is much decreased, thereby indicating that they will in the next series adhere no longer.

The **FIRST FINGER JOINT** (PL. VI. fig. 12. to 14.) is of a reniform shape, but slightly convex on its inferior surface, and concave on the superior. On the inside it is excavated, having slight lip-like processes, and behind these at its lower surface, a somewhat obliquely transverse subtriangular ridge, with a longitudinal groove at its apex for the admission of a similar but undivided ridge of the second arm joint. On the upper surface, a simple subtriangular ridge also appears, showing like that on the former, the aperture of the perforating tube; this joint is entirely free at its sides, and is generally the first that sends off a tentacular process. I possess, however, a fine specimen of **APIOCRINITE**, perhaps the finest ever found (PL. I. fig. 2.) where this took place at the second arm-joint. In this individual, the tentaculum arises from the arm-joint on the right-hand side of the scapula, and from its left side; whereas in the case where the first finger sends it off, it arises from the right-hand side of the joint over the left division of the scapula. The insertion of the tentaculum takes place in a part of the joint which is obliquely truncated on the right side near the superior surface, and forms a concave space traversed by a ridge, having in its centre a perforated cavity.

The **SECOND FINGER JOINT** (PL. VI. fig. 15. to 17.) is also nearly reniform, excavated in the centre of its interior side, and truncated at both extremities, thereby giving insertion on the one side for a tentaculum, and on the other allowing freer scope to that arising from the first finger joint. That side which lies over the insertion of the tentaculum in the former joint, is somewhat thinner than the other, which formation, as it is continued alternately through all the following finger joints, presents an admirable contrivance to furnish an additional dimension of adhering surface, and thence firmer insertion to the tentaculum, without an undue increase in its size. On the inferior surface, where the second finger joint rests on the first, and also on the superior surface, it has a subtriangular ridge perforated in the centre. It also shows at its superior surface, numerous radiating striæ, with interrupted ring-like markings of growth similar to those in the former joints.

The other FINGER JOINTS (PL. VI. fig. 19. to 27.) assume more of a horse-shoe shape, are traversed by a canal, and with regard to their superior surfaces are of two distinct formations. Those of the FIRST FORMATION (PL. VI. fig. 18. and 24.) have on the inferior and superior surfaces, a ridge placed in an oblique direction, so that that on the inferior, crosses that on the superior surface. The finger joints of the SECOND FORMATION (PL. VI. fig. 19. to 24.) have on one side the oblique transverse ridge, (fig. 24.) and on the other, two slender ridges crossing each other at right angles, and sending off throughout the exterior space to the circumference, from one to five less conspicuous radii (fig. 19. to 23.) The joints of the first and second formation are so arranged over each other when forming the finger, (PL. VI. fig. 25.) that the radiated surfaces of two joints of the second formation always adhere together, supporting one of the first, on which again two of the second formation rest.

Although I have not a specimen showing the tentaculated fingers in an entire state, yet from the general simple construction of the APIOCRINITES ROTUNDUS, and the non-occurrence of the cuneiform dividing joints in the strata which afford these specimens, I conclude that the tentaculated fingers were simple, and the animal had no more than two.

From the above observations we may be able to obtain a tolerably accurate idea of the general form, appearance, and organization of this animal in its original and perfect state, and form a restoration of the whole in the same manner that the antiquary proceeds to restore a ruined temple.

We shall then (PL. I. fig. 1.) consider it as attached by its conical base to some marine body at the bottom of a former ocean, whence arose its short and slightly flexible column, terminated at the upper part by the swelling pyriform body which contained its viscera and mouth surrounded by ten fingers, each fringed by numerous tentacula, either expanded like an opening flower when the animal was in search of its prey, or contracted and closed when in a state of repose.

If we next examine the interior funnel-shaped cavity (PL. III. fig. 1.) we may trace two rows of orifices opening laterally, each row exhibiting five. The inferior orifices open between the first and second costal joint (PL. IV. fig. 14. and 15); the superior orifices open between the junction of the scapula and the two incumbent arm joints (PL. V. fig. 4.) Below the subpen-

tangular aperture formed by the truncated ends of the joints of the pelvis, at the bottom of the funnel-shaped abdominal cavity, we observe the entrance to the alimentary canal, protected by the sphincter muscle of the superior enlarged columnar joint.

To the general idea thus obtained of the organization of this animal, it should be added that the appearances presently to be stated indicate two other important particulars; **FIRST**, that the upper-part of the funnel-shaped cavity containing the viscera, was protected externally by series of small plates leaving a central opening for the mouths, and **SECONDLY**, the existence of lateral opening on the exterior of the circumference of the body, possibly forming the mouths of the ovaries. The appearances leading to this conclusion are, viz.—

We often trace several nearly wedge-shaped four, five, or six-cornered plates (PL. III. fig. 2.—PL. 6. fig. 2. Q.) interposed between the angles of the two second costals, scapulæ, and first and second arm joints, in a line with the lateral surfaces of the scapulæ; and in this part sometimes forming two series. These I consider as analagous to the pectoral plates of the pentacrinites, actinocrinites, &c. and thence conclude that this animal had also an external integument over its abdominal cavity, rendered stronger by the interposition of numerous minute adhering plates, which also spread over the excavated or channelled portion of the arm joints, finger joints, and tentacula, as is the case in *PENTACRINUS CAPUT MEDUSÆ*, in treating of which this structure will more fully be explained. That the abdominal cavity had, in this animal, really such a covering, is rendered further probable by the occurrence of round balls of clay resting sometimes within it, and evidently formed as casts in its interior; (which are erroneously noticed by TOWNSEND in character of *MOSES*, vol. i. p. 269, as opercula) of these the upper surface seems to have moulded against some such covering.

I shall now state the appearances, which I think, may possibly be considered as indicating the mouths of the ovaries of this animal. In or between the lateral surfaces of the joints of the pelvis and the insertion of the first costal joints, we may frequently trace a violent contraction, rendering this part of the animal subpentangular (PL. VII. fig. 12.) and in the same parts we also observe more or less elevated tubercles, (PL. VII. fig. 7. 11. 12. 13) having a central perforation, which in one instance I have traced (fig. 7.) to pass through the joint of the pelvis into the space between it and the costal joints, extending perhaps

thence into the funnel-shaped cavity. This has suggested to me the idea that it might have led to an ovary having five ducts, somewhat similar to that of the echinus.

Externally the superior portions of this animal are frequently marked with minute indentations (Pl. I. fig. 2.) the points of adhesion probably of the epidermis, or rather periosteum, which secreted their calcareous matter. In some instances I believe I have detected traces of this epidermis in a fine overlaying pelicle.

If the periosteum of any single joint received an injury, the further secretion in that part was discontinued, and the periosteum of the neighbouring parts filled the vacancy thus occasioned; this produced a wedge-like interposition and deformity of the joints of the column, which thereby appear as if formed of several parts; a similar distortion of the pelvis, &c.—Pl. VII. fig. 1. to 6. 8. to 10.

Although the whole skeleton of the animal is now changed into calcareous spar, still, as has been observed, the difference of colour not unfrequently points out the gradual formation of its various parts: hence we may, perhaps, reasonably conclude that the original colouring matter has been retained through all the changes the substance underwent. In fine specimens this is a beautiful dark purple, varying in a most elegant manner into a pale red purple, and to a more or less dark gray, as may more particularly be seen in sections of the base.

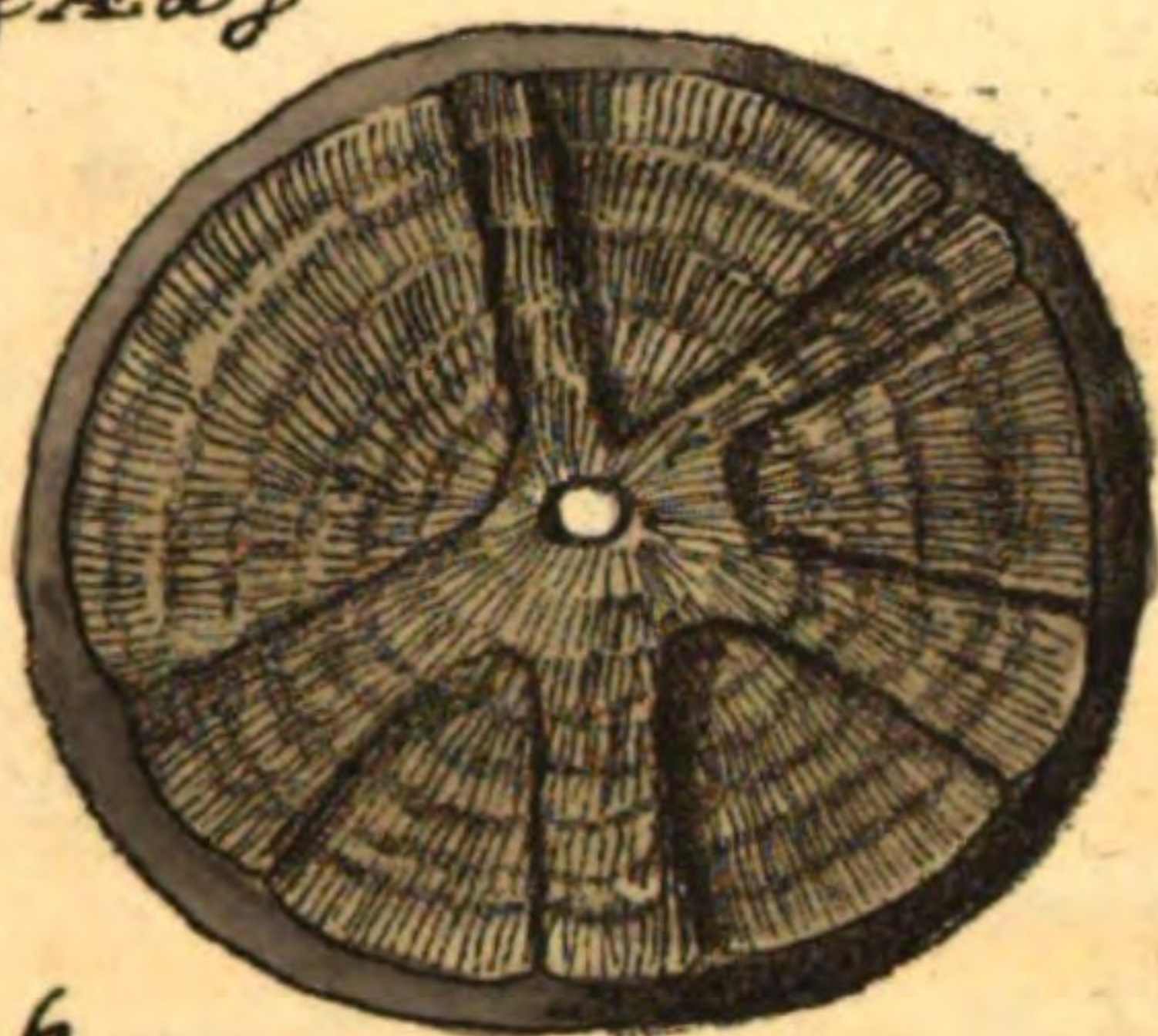
These colours, however, appear only to have been retained in those specimens which either were, or had very recently been, living at the period of their becoming enveloped in the strata which now preserves them. Those which had been at that period dead for some time, must have already from various evident causes, lost much of the vividness of the original colours before they were thus inhumed. This appears to me to have been the case with those specimens which so frequently occur, having an uniform gray colour, becoming tinged by further decomposition with yellow, and gradually converted into a kind of ochre.

The calcareous particles which have filtered into the alimentary canal and the various cavities between the joints (if these were free of extraneous matter) often form there a nucleus of foliated spar, and sometimes occur as casts

APIOCRINITES ROTUNDUS.

PL. VII

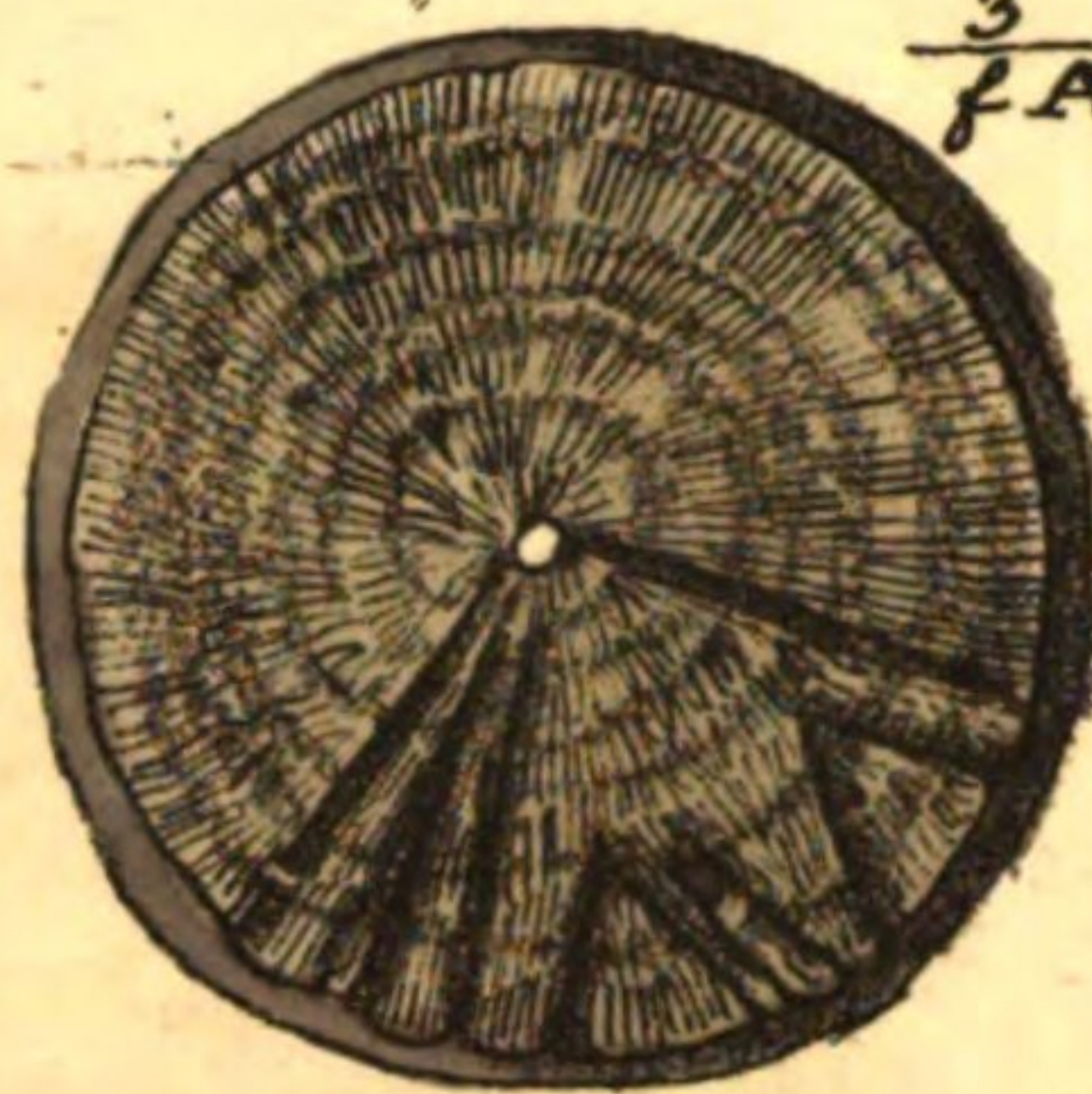
$\frac{1}{f \cdot E \cdot d \cdot j}$



$\frac{2}{f \cdot E \cdot j}$



$\frac{3}{f \cdot E \cdot j}$



$\frac{4}{f \cdot E \cdot j}$



$\frac{6}{f \cdot E \cdot d \cdot j}$



$\frac{5}{f \cdot E \cdot j}$



$\frac{10}{E \cdot d \cdot j}$

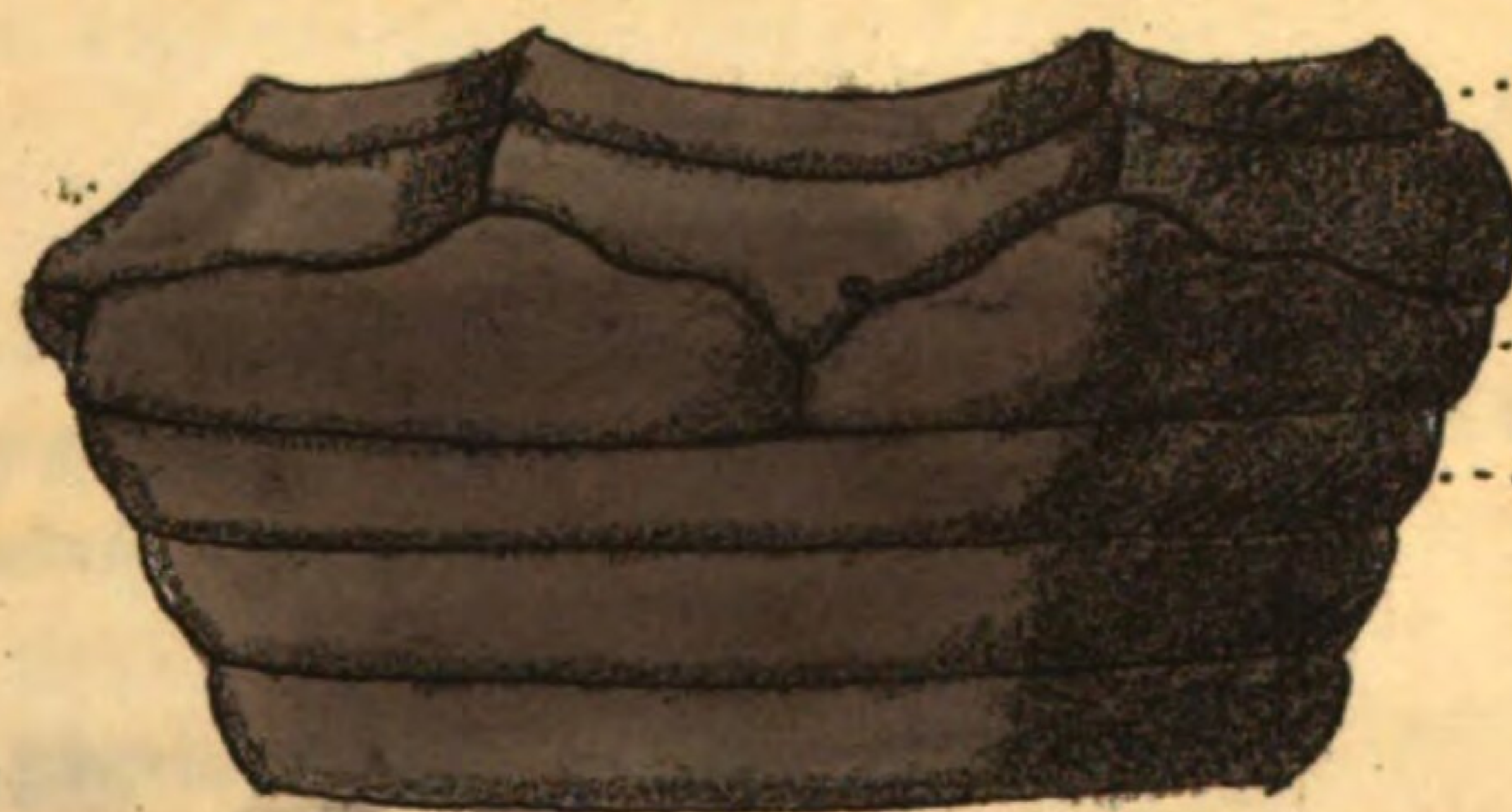
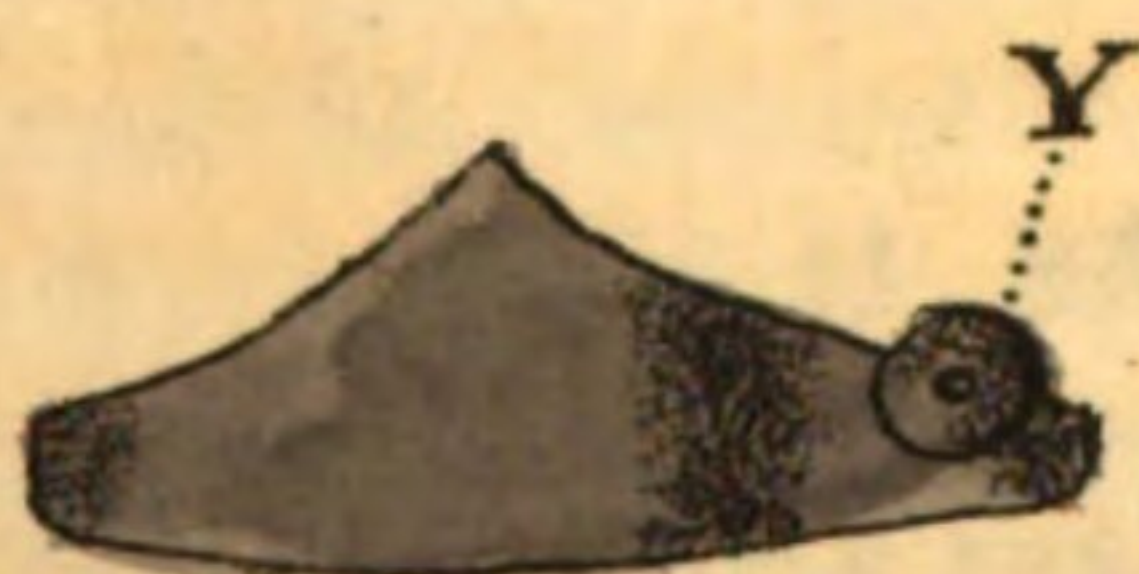
$\frac{8}{f \cdot E \cdot j}$

$\frac{9}{E \cdot j}$



$\frac{11}{E}$

$\frac{12}{E}$



$\frac{6}{F}$

$\frac{8}{F}$

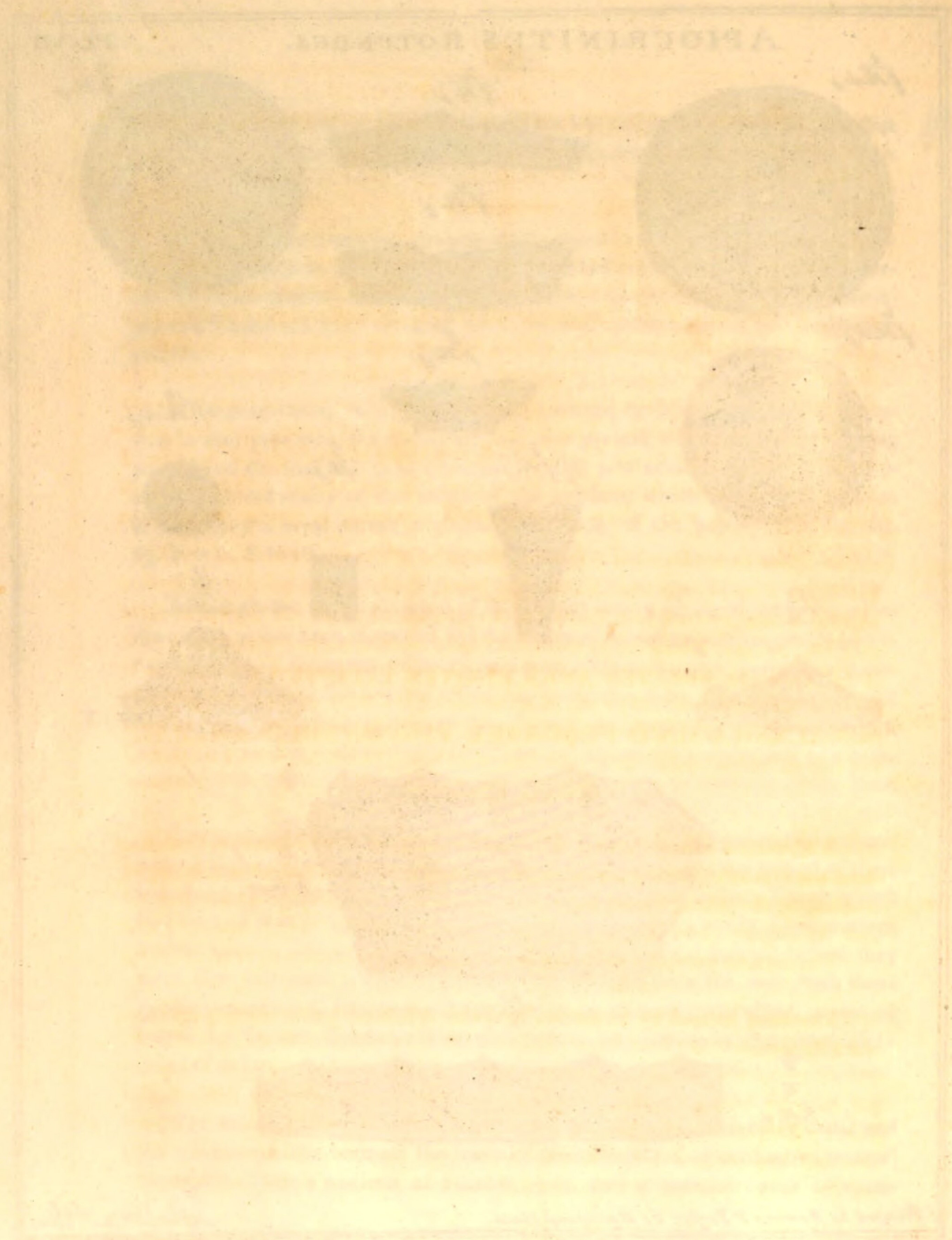
$\frac{9}{E}$

$k \cdot E \cdot d$

$\frac{13}{Y}$

$\frac{a}{F}$
 E
 $k \cdot E \cdot d$





sembling the screw stones well known in the chert accompanying the mountain limestone.

Since the above description of *Apiocrinites rotundus* went to press, I have seen C. C. SMIDELS, M. D. *Vorstellungen einiger merkwürdigen Gesteine*, 1780, who represents (PL. VI. and VII.) an *Apiocrinites* from the Canton of Solothurn. This figure corresponds with *Hofer*, and suggests to me, that the specimens from Switzerland are, if not a distinct species, at least a variety of *Apiocrinites rotundus*. The thickness of the first costæ, and less pear-shaped form, appear to be characteristic. Should it prove a new species, I propose for its name *Apiocrinites elongatus*. In the tabular arrangement of the Crinoidea it will follow *A. rotundus*, rendering a further subdivision necessary.

II. SPECIES APIOCRINITES ELLIPTICUS.

OVAL COLUMN'D PEAR-LIKE LILY-SHAPED ANIMAL.

Specific Character.

A Crinoidal animal, having a column composed of oval joints articulating by a transversely grooved surface; the two upper joints of the column enlarged, sustaining the pelvis, costæ, &c.

The column provided with auxiliary side arms.

The base formed by numerous irregular columnar joints sending off fibres for adhesion.

Reference and Synonymes.

Bottle Encrinite—PARKINSON'S Org. Rem. vol. 2. PL. XIII. fig. 75. and 76.

Strait Encrinite—(a young undeveloped species).—PARKINSON'S Org. Rem. vol. 2. PL. XIII. fig. 34. and 35.

Stag Horn Encrinite—(the base of *A. ellipticus*).—PARKINSON'S Org. Rem. vol. 2. PL. XIII. fig. 31. 38. 39.

Chalk Bottles—vulgar name of the quarrymen.

Luidii Lithophylacii Britannici, t. 13. fig. 1163. and 1164.

Locality.

The Chalk Pits of Wiltshire and Kent.

Description.

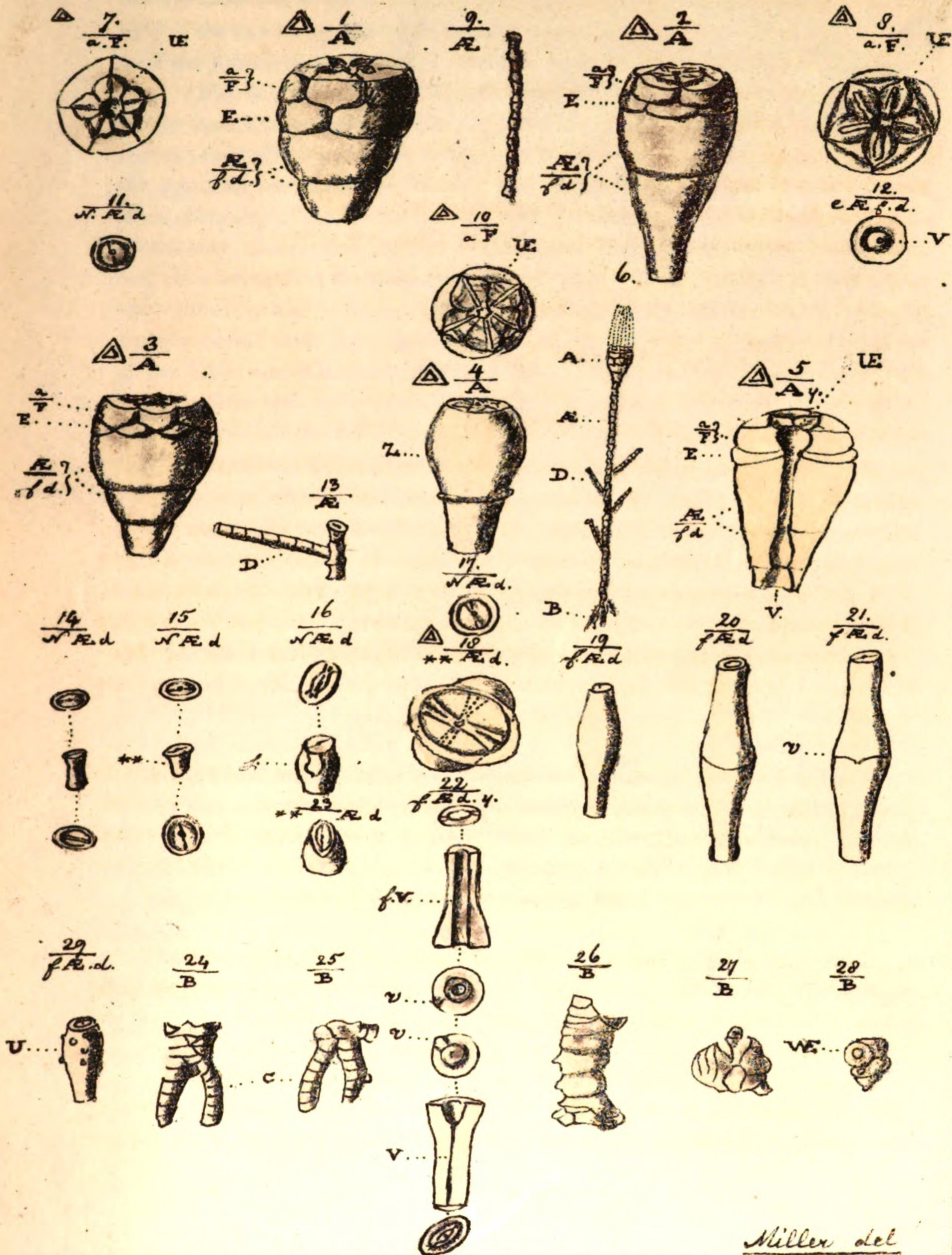
The elliptical shape of the columnar joints has induced me to assign to this animal its specific name. It is found only fossil, and always in a mutilated state in beds of the chalk formation. It is a small neat species, whose column was, I apprehend, in proportion longer than that of the former species. An idea of its probable appearance when perfect, I have endeavoured to convey, fig. 6. in the annexed plate, which representation is, however, less than the natural size, having also omitted the terminations of the auxiliary side arms, of whose formation I have not the slightest idea, and the tentaculated fingers as yet not detected.

The COLUMN of this Crinoidal animal offers a new field for inquiry, since its joints appear to have consisted in a much greater degree of cartilaginous matter and muscular integuments, especially in younger specimens. Perhaps their superior and lower surfaces alone, may, during the early stages of their growth, have presented a solid calcareous mass.

The articulating surfaces at both extremities of each joint present elliptical areas (14. to 18.) bounded by slightly raised rims surrounding an inner oval, which again swells and becomes convex. In the direction of the longitudinal axis are placed two narrow ridges, one on either side, in the centre of which is a small round perforation, containing the alimentary canal. (18). It should be remarked that the direction of the longitudinal furrows, and indeed of the whole oval areas of the articulating surfaces, does not ge-

APIOCRINITES

ELLIPTICUS



Miller del

nerally coincide at the opposite extremities of the same joint, the longitudinal axis of the one being placed obliquely when compared with that of the other, as if the joint had been twisted round in opposite directions at its two extremities. (This is represented in fig. 18. by dotted lines.) I have never found a single instance in which this obliquity was not observable, although there are reasons for believing that when the animal was fully extended, the direction of the opposite surfaces must have become coincident, as in the *PLATYCRINITES*. This obliquity of the two elliptical surfaces, appears to have resulted from a vermicular contraction extended from one joint to the other, through the muscle surrounding the alimentary canal, which being inserted in the transverse grooves, and acting on them like a screw driver, twisted them partially round; hence, from the compression thus produced, we see the circumference of the joints sometimes barrelshaped (16.) or more or less round towards the centre, while near the articulating surface it remains elliptical. The barrel-shaped joints are thicker in proportion, and appear to have lost their soft cartilaginous texture, having probably belonged to full grown animals; this, indeed, seems to be confirmed by some of the specimens exhibiting a formation in concentric rings, like that observable in *Apiocrinites rotundus*, and an exterior partial separation. (16.) The alimentary canal is generally small, but appears to have enlarged considerably in some parts of the column (22.) and in this case elongated the joints containing it, and at the same time strengthened their adhesion with the neighbouring joints by secreting and accumulating calcareous matter around it, (20. to 22.) In some specimens (20. to 22.) of this description, the line of junction between two joints, instead of being as usual straight, becomes inflected and waved, apparently in consequence of having been acted upon by a muscular contraction, and in one instance, the exuded calcareous matter has completely obliterated the external mark of articulation between two joints (19.) which have anchylosed therefore to each other. *LATERAL AUXILIARY ARMS* (13.) appear to have proceeded occasionally from the column at irregular intervals, the joints composing them are round, and probably articulated by radiating surfaces, as is the case in *PLATYCRINITES*.

The *ENLARGED COLUMNAR JOINTS* at the summit of the column, I apprehend to have articulated similarly to those of ordinary size, and in a section (5) in my possession I have traced the alimentary canal passing through their centre, enlarging in the second joint.

In the disposition and general figure of the joints (1. to 3.) forming the upper

part of this animal, so far as the state of the specimens of this species have allowed me to trace them, it perfectly resembles *Apiocrinites rotundus*. As in that species, the SUPERIOR COLUMNAR JOINT is on its upper surface divided by five ridges, admitting in the concave spaces the five joints of the PELVIS, each of these terminate above in an elevated ridge, and in the interstices between them the insertion of the five FIRST COSTAL JOINTS takes place. The funnel-shaped cavity in the centre, resembles that of the former species. The exterior muscular integument sometimes appears to have hidden the insertion of the joints, (4.) and its contraction will account for the folds which occasionally occur on the surface. I have as yet seen no specimen continued beyond the first costal joint, but apprehend that the following ones, the scapulæ, &c. will also be found to resemble those of *Apiocrinites rotundus*.

The STRAIGHT BOTTLE ENCRINITE described by Mr. PARKINSON, is, probably, only a young individual of our species, or perhaps, a much contracted specimen, having apparently hardly sufficient character to be considered as a variety.

The STAG-HORN ENCRINITE of the same author, I apprehend to be part of the column of our species, near the base sending off its auxiliary fibres, and thereby forming a fascicular ramifying root, by which the animal attached itself to extraneous substances. That these specimens really formed the roots of our present species, and not portions of a distinct animal, I am induced to believe from having noticed that the mode of articulation of their joints when it can be clearly traced, appears to me to present the same character as has been noticed in the columnar joints described above; and although the proportions of these radical joints are much thinner, broader, and frequently irregularly bevelled, so as at first sight to militate against this appropriation; yet a similar difference between the upper columnar and radical joints of other genera, will hereafter be pointed out.

II. GENUS ENCRINITES.

TRUE LILY-SHAPED ANIMAL.

Generic Character.

A Crinoidal animal with a column formed of numerous round depressed joints, adhering by a radiating grooved surface, and becoming subpentangular near the pelvis, which is composed of five pieces, giving a lateral insertion to the first series of costal plates, to which the second series and scapulæ succeed, whence the tentaculated arms or fingers proceed, formed by double series of joints.

Observation.

The animals of this genus have not hitherto been found in a living state, nor do I believe that their remains have been discovered in England. They appear to be of very local occurrence. As there occurs but one species *Encrinurus moniliformis*, its illustrative Plate II. forms also an explanation of the generic character.

I. SPECIES ENCRINITES MONILIFORMIS.

BEAD COLUMN'D TRUE LILY-SHAPED ANIMAL.

Specific Character.

A Crinoidal animal with a column-formed of numerous round joints, alternately, as they approach the pelvis, larger and smaller, becoming subpentangular when nearly in contact with it. On the pelvis, formed of five pieces, adhere laterally the first series of costæ, on which the second series of costæ is placed, succeeded by the scapulæ from which the ten tentaculated arms or fingers proceed.

Animal permanently affixed by exuded indurated matter.

Reference and Synonymes.

Encrinus Liliiformis.—LAMARCK.

Stone Lily.

Encrine.—Lys de mer.—French.

Lilium Lapideum.

LACHMUND.—Oryctographia Hildersheimensis.

A. RITTER.—Oryctographia Goslariensis, 1738. tab. 1. fig. 3.

BRUCKMAN'S Thesauri Subteranii Ducatus Brunswigii.

F. BEUTH.—Julia and Mantunn Subterranea, 1776, p. 85. fig. 2.

KNORR.—Petrif. I. tab. 11. a. Supl. 7. e. 1. 2. 4.

Rosinum tentamen de Lithozois, tab. 2.

J. C. HARENBERG.—de Encrino siv. Lilio lapideo, 1729, tab. 1. and tab.

1. Appendix (good figures).

Schulz Betrachtungen versteinerter Seesterne.

Naturforscher Stueck, 3. 6. 8. 11.

Beptraege zur Naturgeschichte Altenburg, 1774.

HOFER, Jun.—In Acta Helvetica, vol. 4.

PARKINSON'S Org. Remains, vol. 2. p. 14. fig. 1. to 3. roots 4. and 5.

Locality.

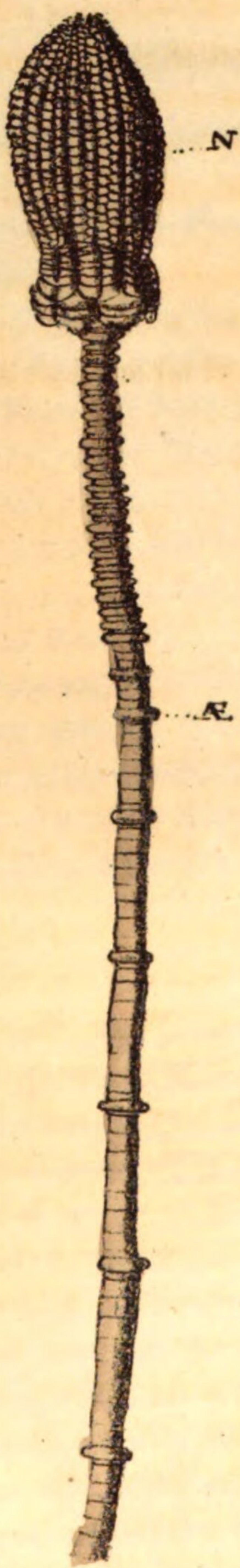
Hildersheim in Lower Saxony (**LACHMUNDEN**) Rakenberg, near Goslar, in Lower Saxony. (**RITTER**.) Schwerven in Juliers, in Westphalia. (**BEUTH**.) Oberscheden and Azzenheusen, not far from Gemenden, in lower Saxony. (**ROSINUS**.) In a German publication, **Der Naturforscher**, 11th. **Stueck**. **MEINECKEN** states that the remains of the stone lily are found abundantly at the village of Erkerode, in Brunswick, about two miles from the town bearing this name, near a wood called the Elm. The quarry is on the declivity of a hill overgrown with wood, on which account the inhabitants oppose the digging after them; the stratum containing them is hardly 15 to 18 inches in thickness. Under the surface of the earth, is a friable, porous, argillaceous limestone, containing millions of columns, and columnar joints; but many hours digging is necessary before a good specimen of the superior part or stone lily can be procured, since the moisture in the stone contributes to their rapid destruction, and their occurring on large pieces of stone makes them liable to separation, which accounts for the many mended specimens. In a publication **Beptraege zur Naturgeschichte**

The first part of the paper is devoted to a general discussion of the problem of the existence of a solution of the system of equations (1) for arbitrary values of the parameters α and β . It is shown that the system (1) has a solution for arbitrary values of the parameters α and β if and only if the matrix A is nonsingular. The second part of the paper is devoted to a detailed study of the properties of the solution of the system (1) for arbitrary values of the parameters α and β . It is shown that the solution of the system (1) is unique and depends continuously on the parameters α and β . The third part of the paper is devoted to a study of the properties of the solution of the system (1) for arbitrary values of the parameters α and β . It is shown that the solution of the system (1) is unique and depends continuously on the parameters α and β . The fourth part of the paper is devoted to a study of the properties of the solution of the system (1) for arbitrary values of the parameters α and β . It is shown that the solution of the system (1) is unique and depends continuously on the parameters α and β .

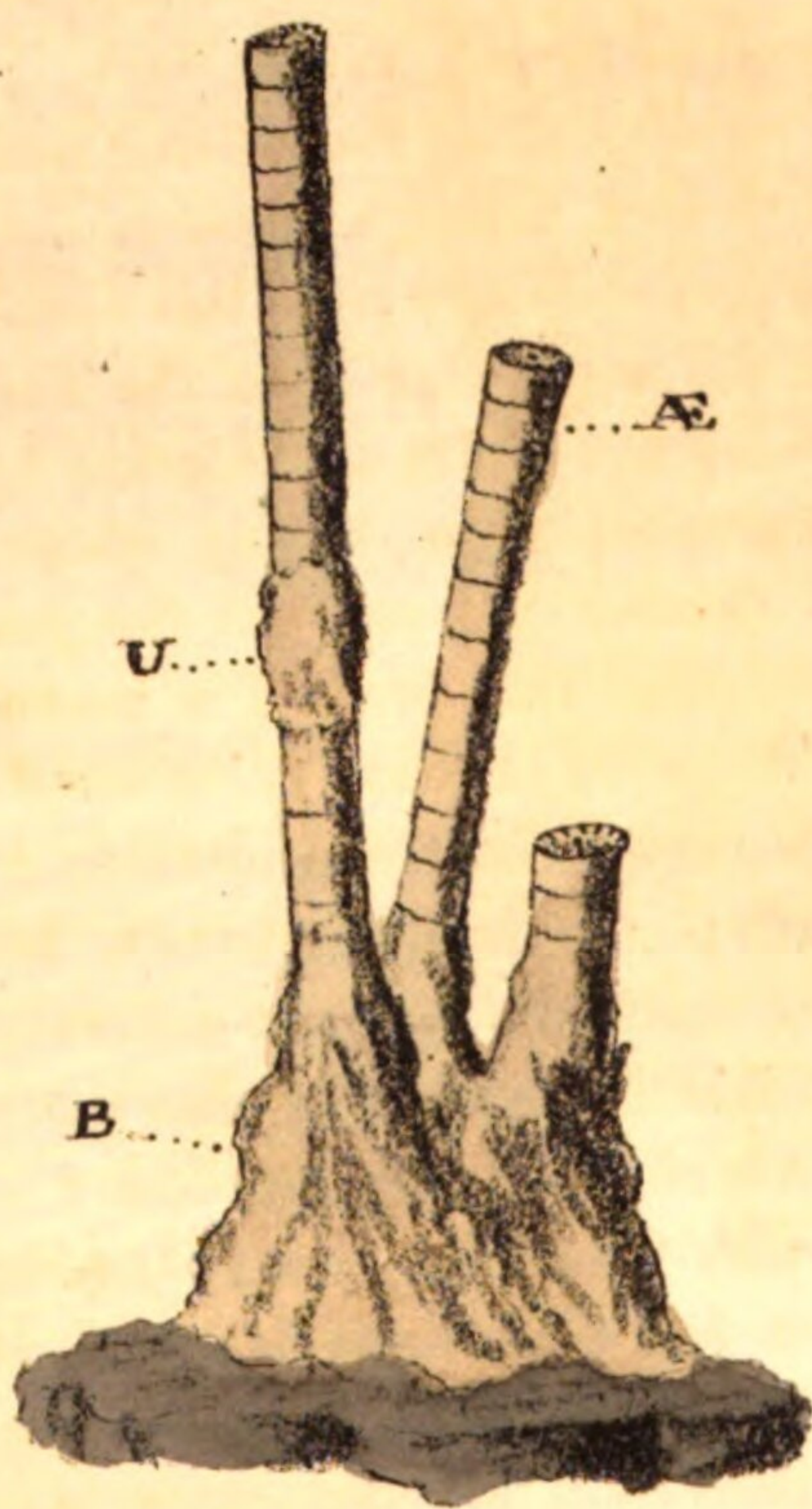
ENCRINITES MONILEFORMIS

PL. I.

$\frac{1}{A}$



$\frac{2}{B}$



$\frac{3}{A}$



$\frac{4}{A d}$



Miller. del.

Altenburg, 1774, it is asserted that the Emperor of Germany offered 100 dollars for a stone lily free from its matrix and attached to its column. Another and harder stratum under the above contains numerous crinital remains, but according to the quarrymen no stone lilies. Schrapland near Halle (*Naturforscher* St. 3.) Farrenstadt near Querfurt (*Naturforscher*, St. 6.)

There is good reason to believe that the formation in which these remains are found near Brunswick, corresponds with the white lias of England, as it appears to repose on the newer red sandstone, containing salt and gypsum.

Description.

The COLUMN (PL. I.) of this animal, which is of considerable length, is formed of numerous round, rather thick, joints, articulating by their striated surfaces; the radii marking them being near the exterior circumference, having a central smooth area, through whose centre the small alimentary canal passes. As the column proceeds upwards, this simple figure of the joints appears to be interrupted (if we may judge from the fine specimen represented in KNORR, T. XI. a.) at every 6th or 7th articulation by a joint of wider diameter, and of a globular depressed form, having above and below it a still more compressed one. Nearer the summit the joints become thinner and rounded externally, assuming the form of a much depressed and oblate spheroid. They are here disposed alternately, a small one between two larger ones, and again every other larger joint considerably greater. When close to the pelvis, the same alternation in size continues, but the joints assume a pentagonal shape, to which the radiating striæ accommodate themselves. (PL. II. fig. 3. PL. III. fig. 1.) The middle of these has a pentapetalous impression or perforation, through whose centre the alimentary canal passes. It is not difficult to see the reason why the columnar joints are pentagonal near the apex, since this is the best figure for allowing additional free motion to the first costal joints, which adhere to and project over the exterior side of the pelvis; the pentapetalous perforation or impression in the superior joints appears to be plainly an enlargement, though a very trifling one, of the alimentary canal, and also to result from the muscles acting on the interior points of the five plates forming the pelvis; hence this figure is obliterated in the lower joints. The frequent alternations of the compressed globular joints near the upper extremity of the column, are evidently intended to permit a greater degree of lateral motion, and their subsequent occasional occurrence allows its free con-

tinuation through a considerable length of the column, before it becomes confined to a more limited flexibility.

From the fine specimen figured by KNORR, it is obvious that the animal had no auxiliary side arms, and as the superior part is less ponderous than that of *Apiocrinites*, we may easily account for its being sustained without them on a longer column.

The BASE (PL. I. fig. 2.) ROSINUS HARRENBURG, WALCH, and Mr. PARKINSON, suggest the idea that the animal was permanently affixed by exuded calcareous indurating secretions, and figure specimens found in the same places where the lily-shaped superior portions of the animal occur. Although I have not myself seen any of these bases, yet from these representations much resembling the attaching laminar portion of *Apiocrinites rotundus*, I cannot hesitate in admitting the accuracy of the observations of the authors above quoted. Hence it is easy to explain the manner in which several of the encrini adhered together, having early commenced life near each other, and become enclosed at the base by the exuded calcareous matter as they grew up, yet without forming one animal as WALCH suggests.

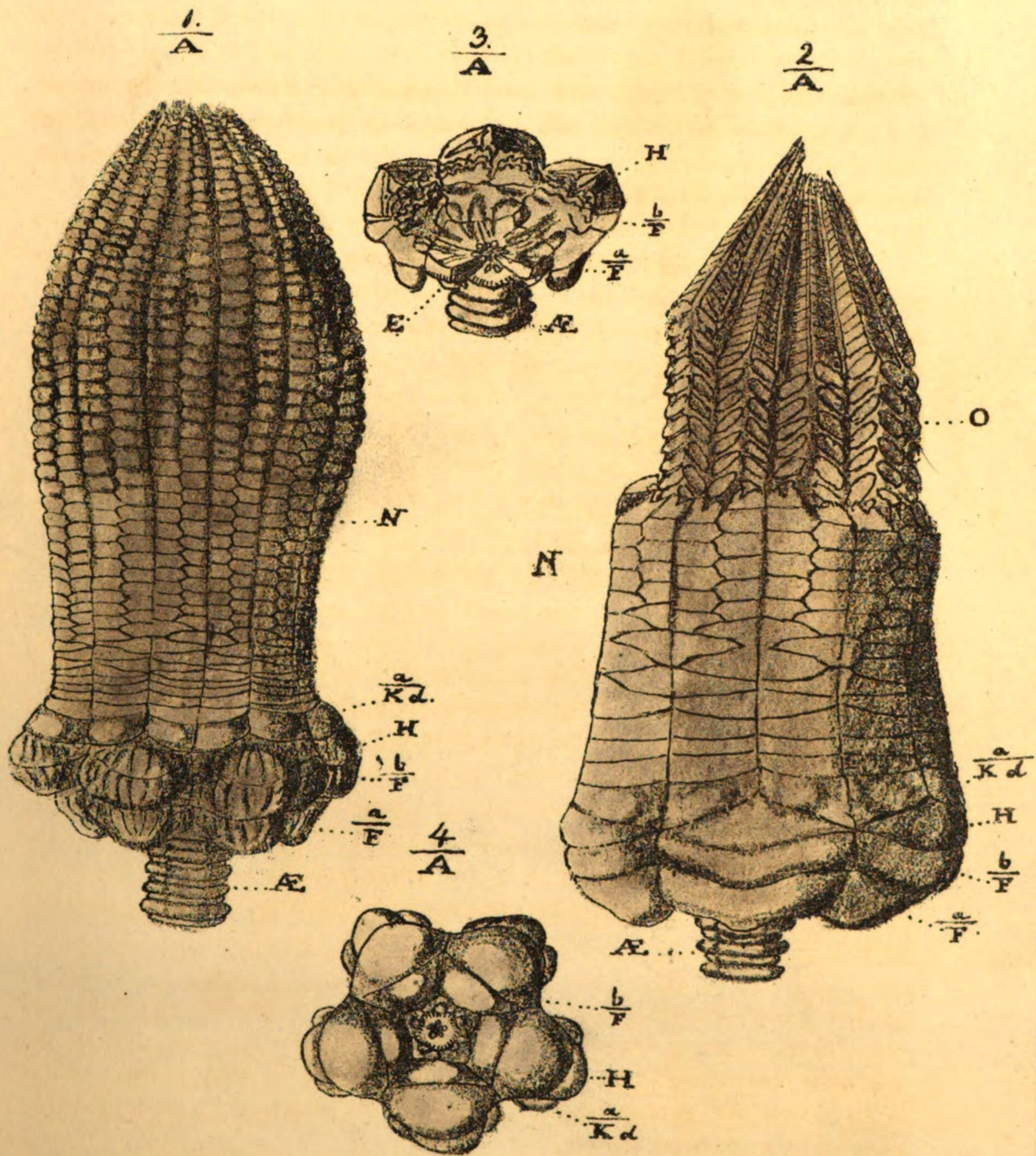
SUPERIOR EXTREMITY. (PL. II.) This part in the number and disposition of its joints, presents many general analogies to the corresponding portions in the preceding genus *Apiocrinites* which have been already largely described, yet with considerable subordinate variations of form, principally arising from the upper joints of the column continuing of the same size with the lower, and the consequent narrow area occupied by the pelvis, which in this species forms the commencement of the swelling part, exhibiting a calix-like figure; hence the contiguous parts are obliged to undergo such modification as may accommodate them to this figure.

The FIRST COLUMNAR JOINT (PL. III. fig. 1.) is of a pentangular form, and one of those of larger dimensions which alternate in the superior part of the column it articulates, by its striated exterior rim, like the other joints, and has in its centre the pentapetalous entrance to the alimentary canal probably guarded by a sphincter muscle.

The PELVIS (PL. III. fig. 2. to 4.) is formed of five depressed rhombic joints,

ENCRINITES MONILEFORMIS

PL. II



Miller. del.

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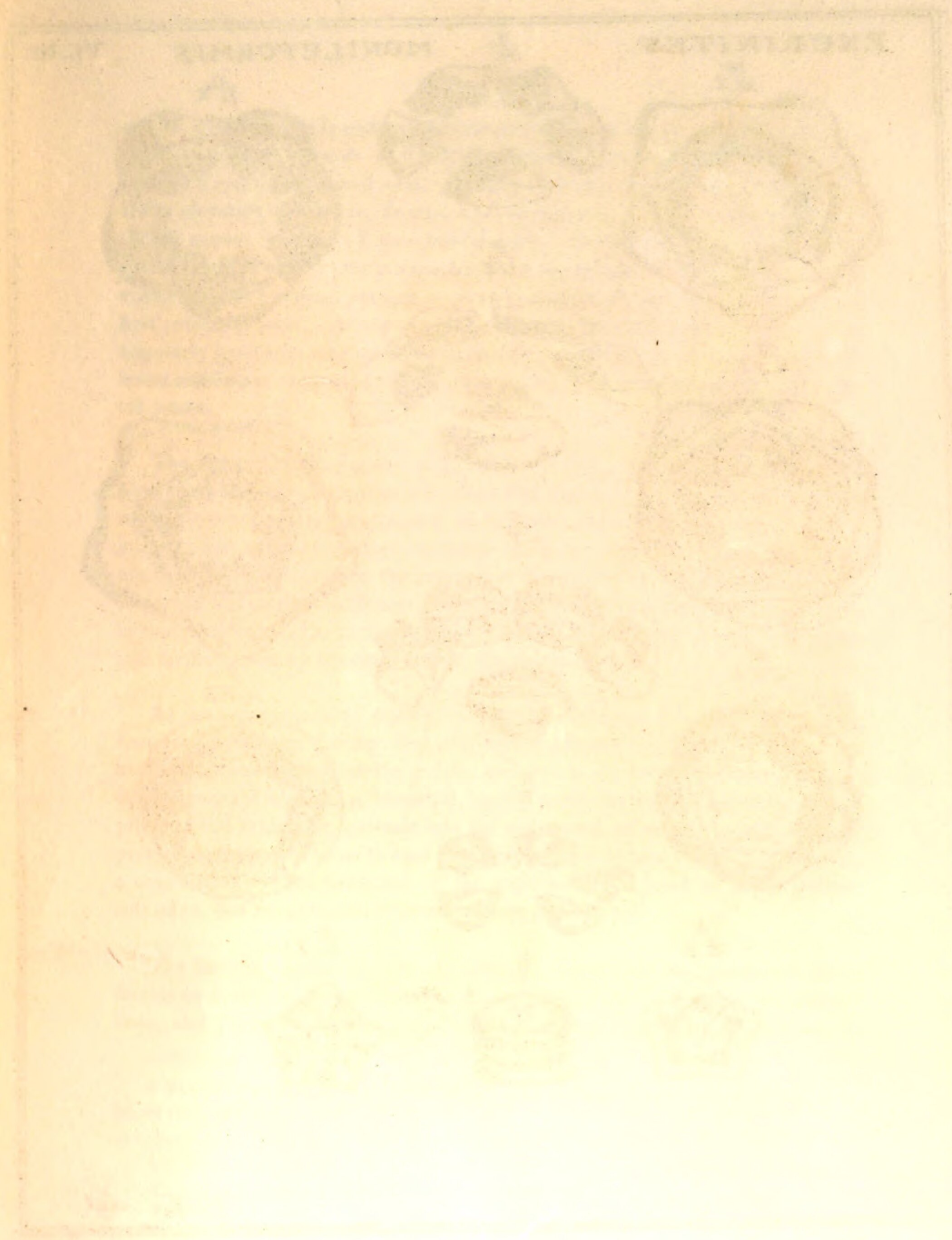
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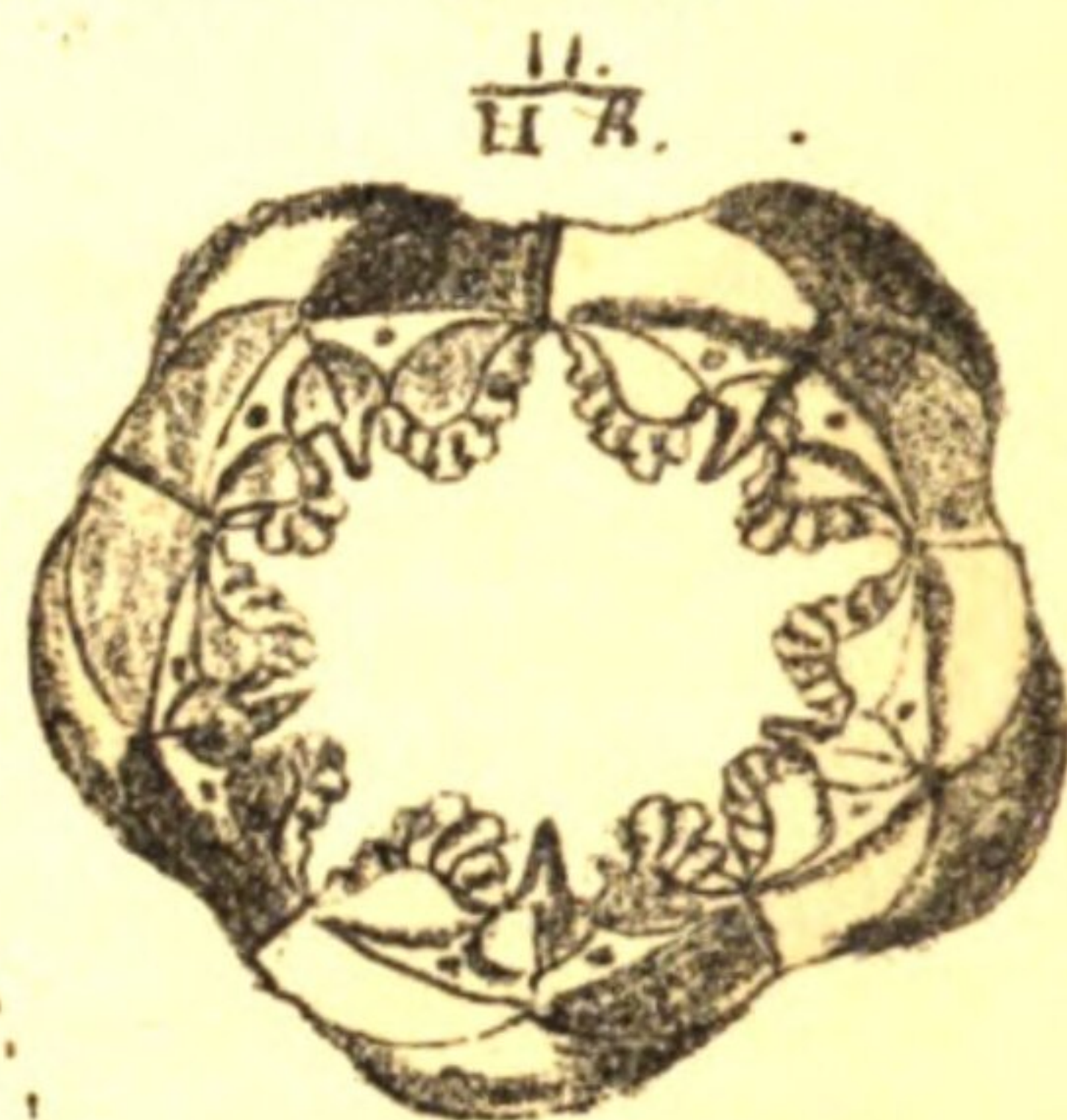
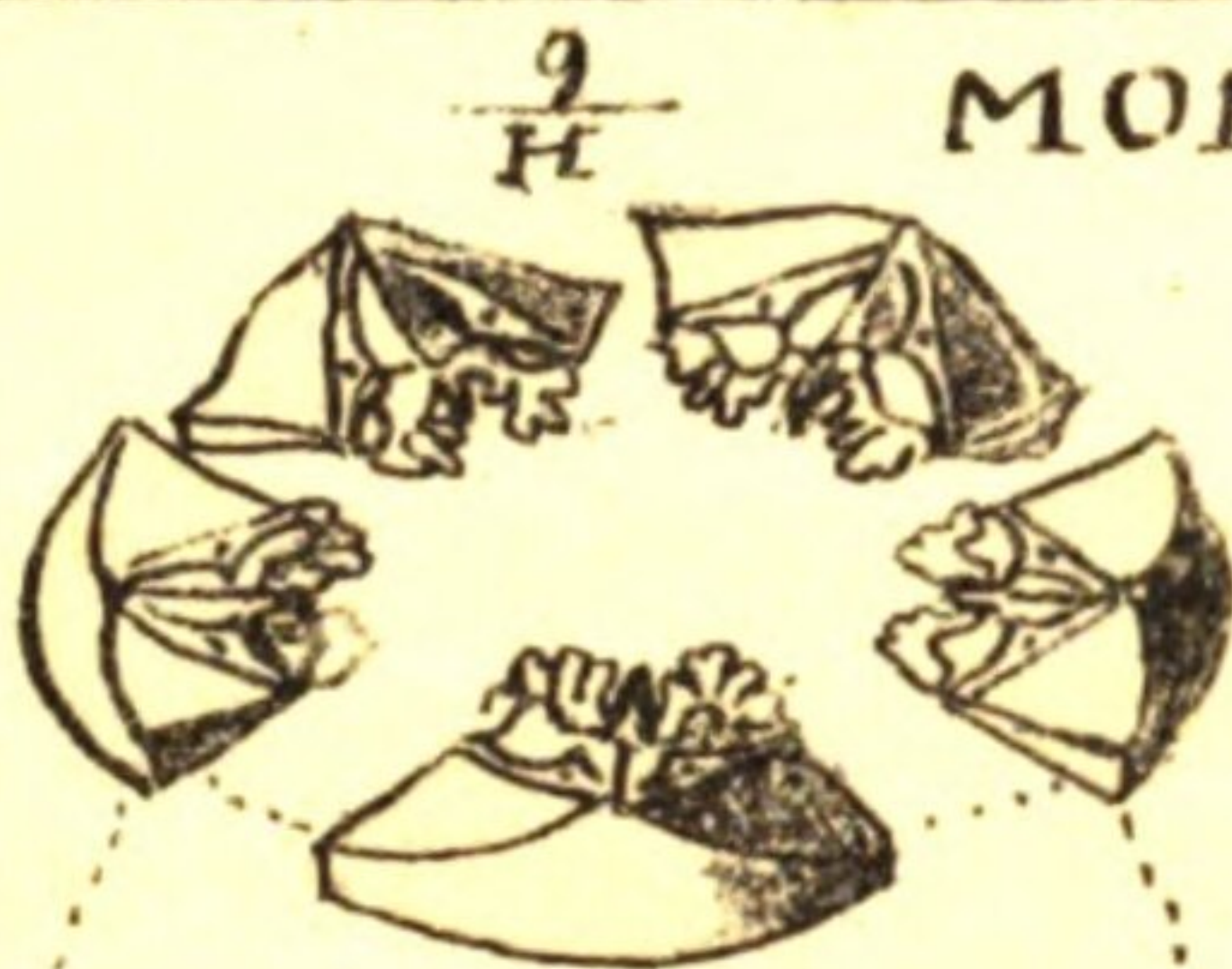
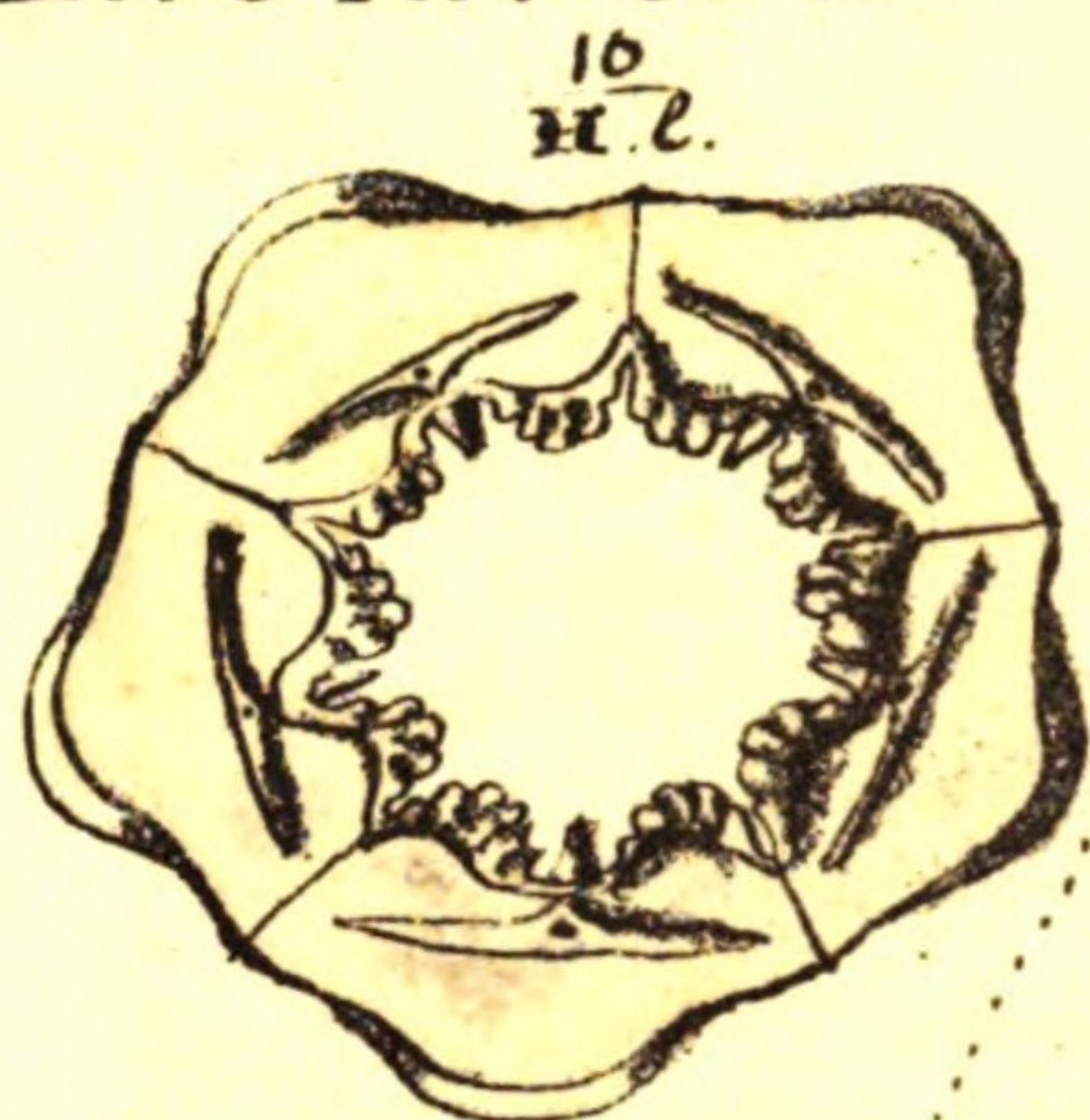
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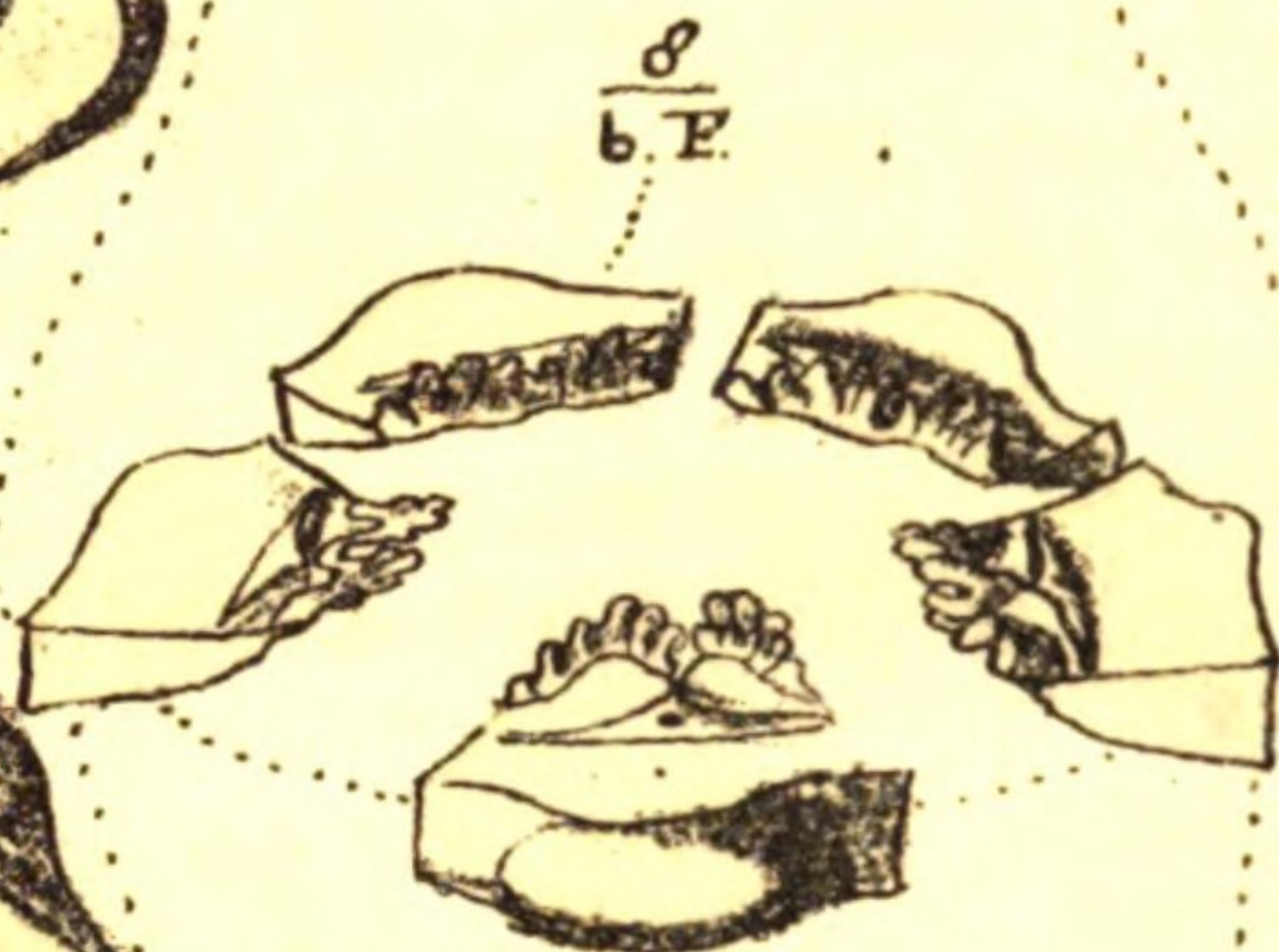
ENCRINITES

MONILEFORMIS

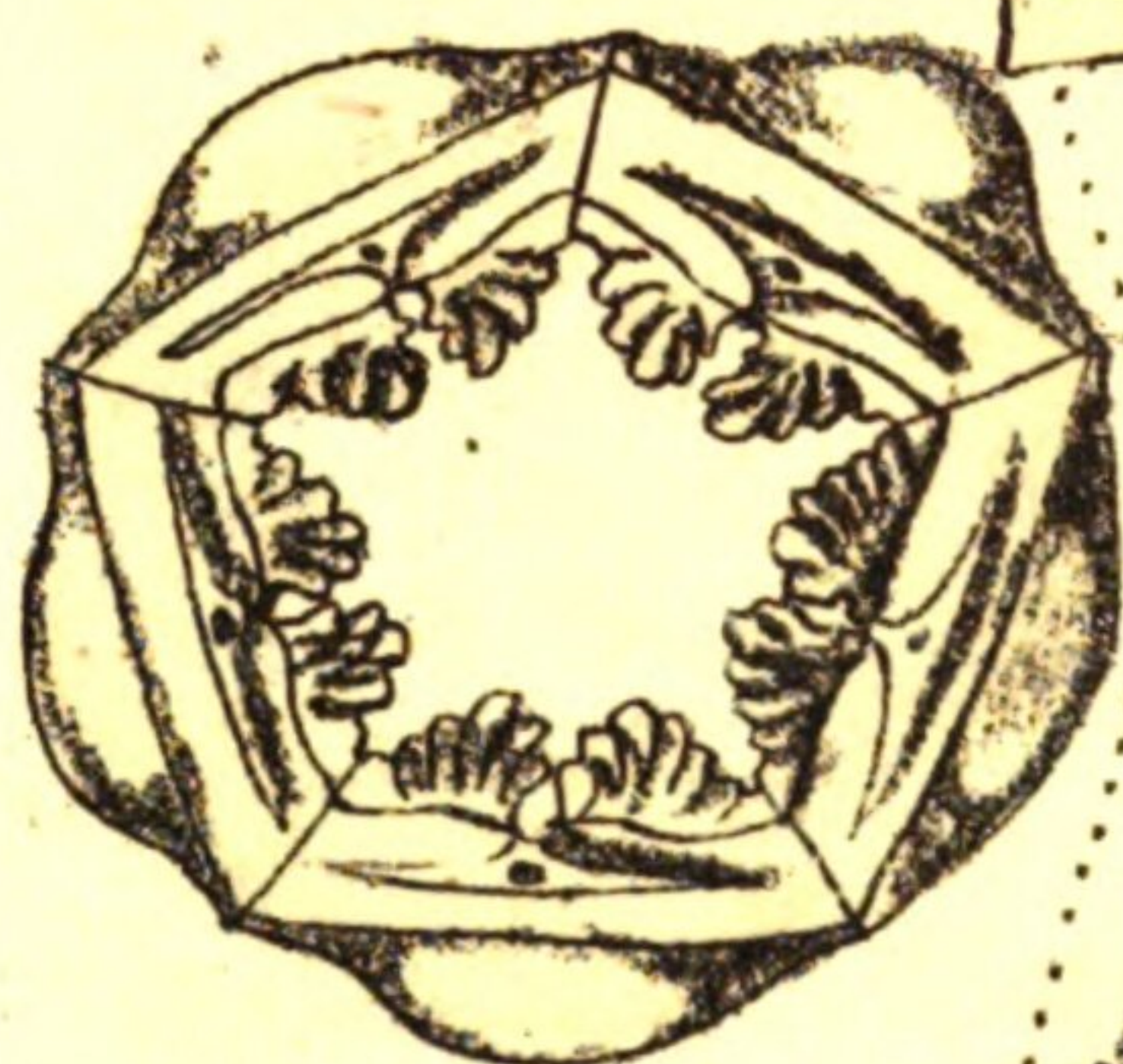
PL. III.



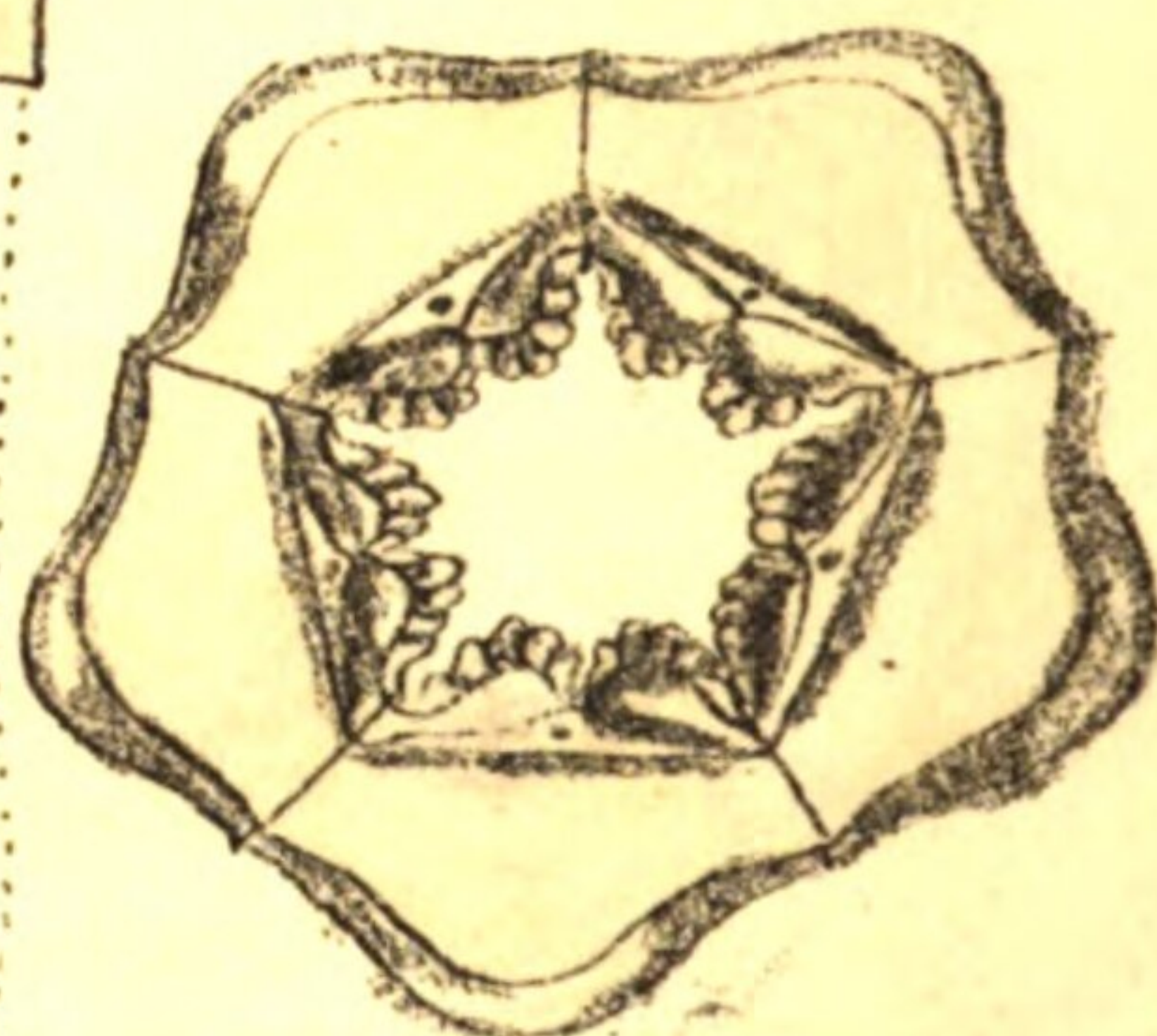
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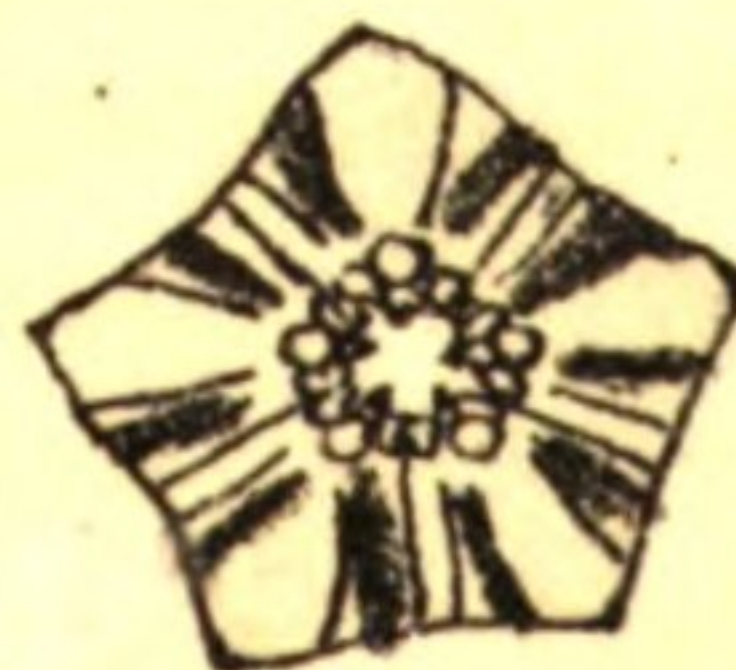
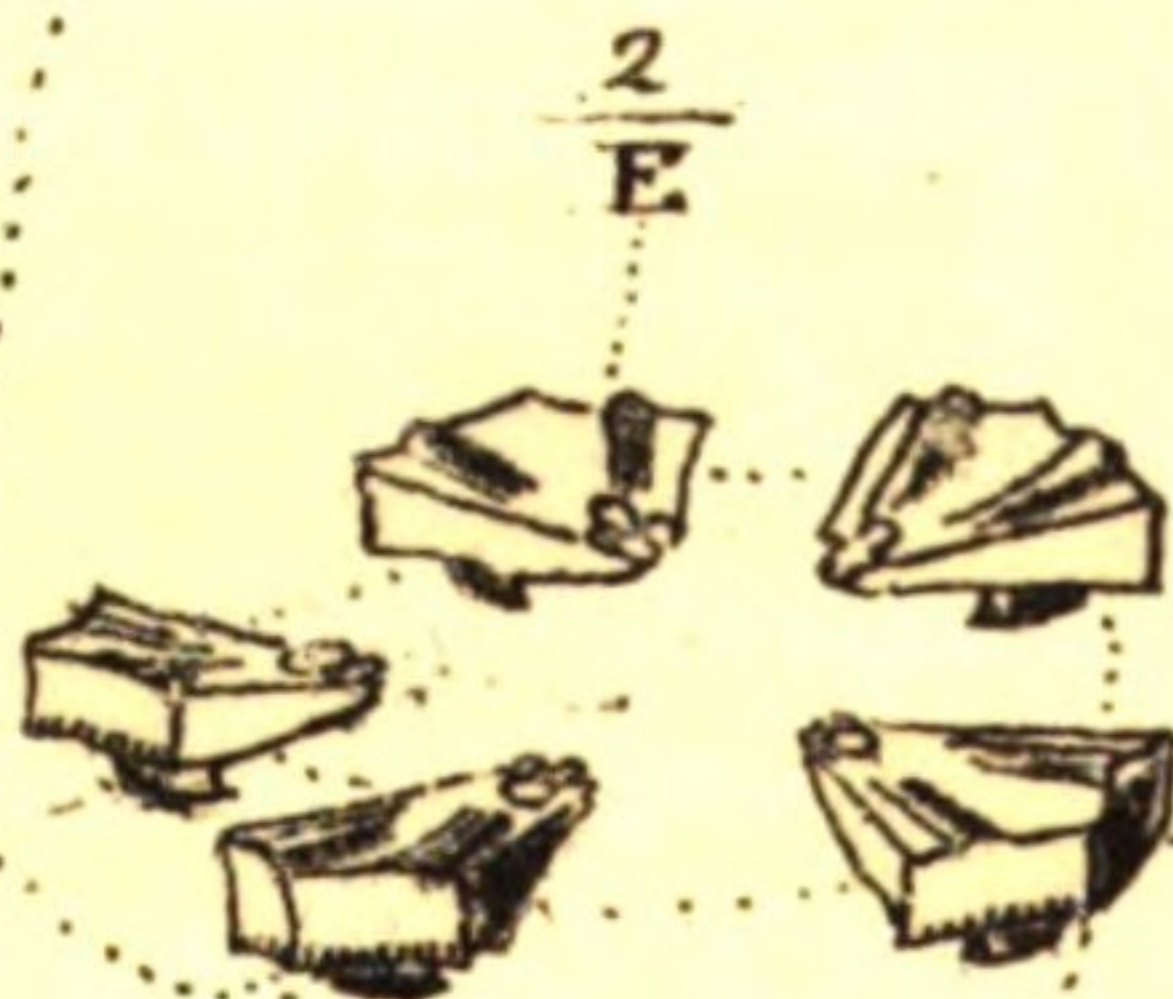
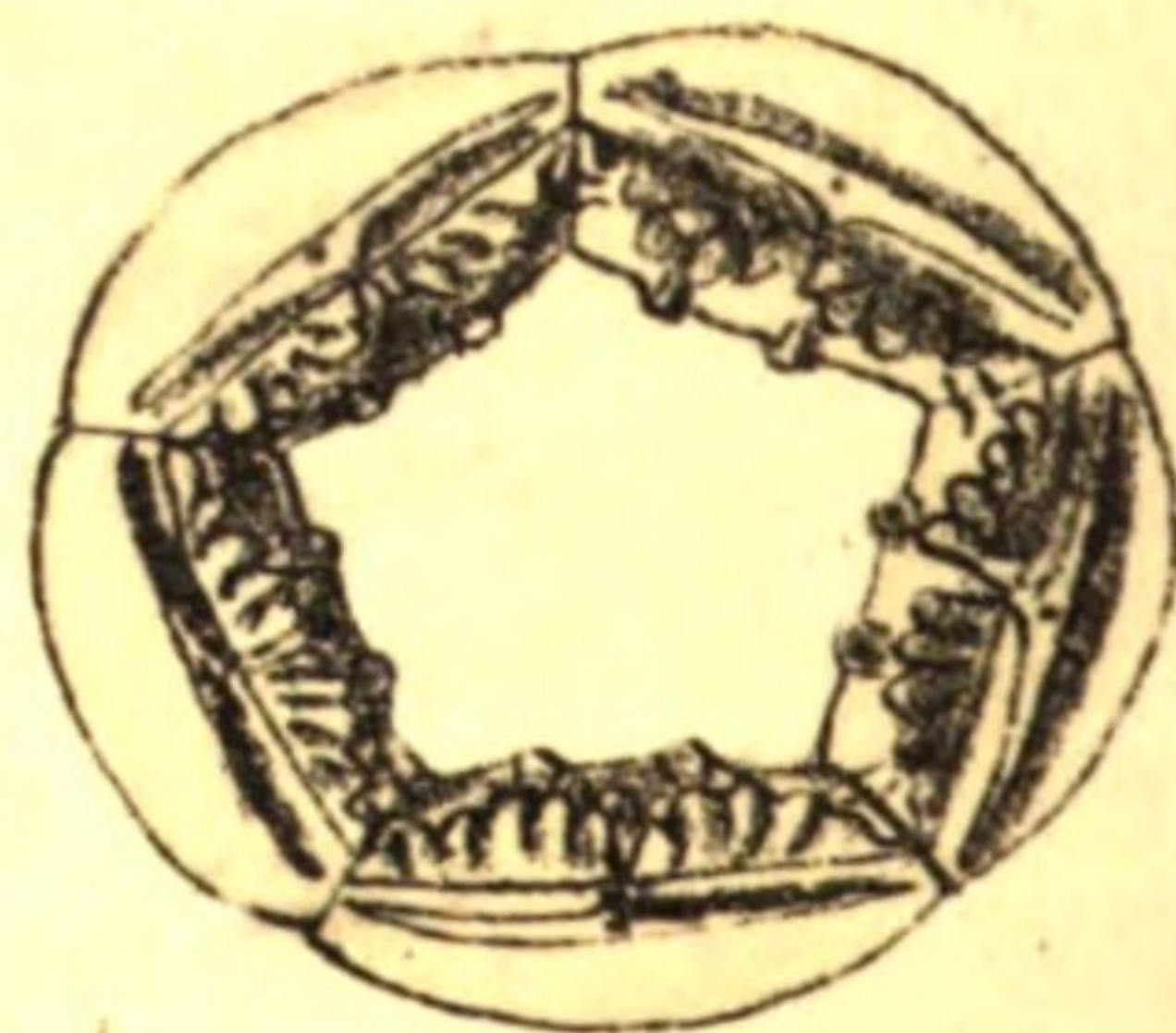
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Miller. del.

one of whose points is somewhat truncated. These are so arranged round a common centre, towards which their truncated points are directed, as to occupy a small pentagonal area. At their truncated point they have a trifoliated elevation (similar to, though less conspicuous than that noticed in the former genus) sending off two lateral folds. Below that part of the pelvis which projects beyond the circumference of the column, each joint has a small subtubercular swelling, serving it as an abutment, for firmer adhesion to the first columnar joint. At the exterior circumference each joint of the pelvis is angularly truncated, so that a pentagonal circumference is formed, whose sides being somewhat excavated and faintly striated, give adhesion to the first costal joints.

THE FIRST COSTAL JOINTS, (PL. III. fig. 5. to 7.) which enlarge outwards, form by their union a pentagon surrounding that occupied by the pelvis, but in consequence of the contraction of the four outer marginal edges of these joints, their external surface becomes convex, and in young specimens almost tubercular; thus, at the junction of the pelvis,* a cavity is left between them and the column, sufficient to allow them space for a free power of motion in that direction: (PL. II. fig. 3, and 4.) and as the animal grows, they gain still farther room by the extension of the pelvis.

At the inner truncated point of each first costal joint, it is excavated transversely in an angular manner, the lower side of this angle showing four folds, two uniting to those noticed on the pelvis, and two to the lateral surfaces. From the subconcave surface, a beautiful highly muscular lip-like process, much plicated and scalloped, extends into the abdominal cavity; the centre of this process is excavated so as to lead to a transverse perforated ridge, thus bearing a near analogy to the formation of the superior costal joint of *Apiocrinites rotundus*, but being infinitely more delicate and elegant.

THE SECOND COSTAL (PL. III. fig. 8. to 10.) bears great resemblance to the former in figure, in the contraction of the margins at the exterior circumference, and its consequent convexity; being almost tubercular in young spe-

* The pelvis on account of its smallness is buried in the cavity, and cannot be seen in a lateral view. (PL. II.)

cimens, in which, if finely preserved, the muscular plicæ of the external integument may frequently be traced, extending over the former, this, and the following joints. At its inner truncated point it has an elegant lip-like process, similar to that noticed on the former joints, the plicæ of both assuming a perfectly conformable disposition, it has at its lower surface the transverse perforated ridge, which also appears to exist at its superior surface. However, this last fact I can only advance hesitatingly on the appearance of a single specimen, and beg to observe, that it does not accord with the organization noticed in the *Apiocrinites rotundus*, to which I have found (speaking in general terms) the present species strictly conformable in this point.

The scapulæ (PL. III. fig. 9. to 11.) rest on the subconcave surfaces of the second costals, and being destined to support a row in which the division of pieces is doubled, the upper surface is formed into an angular ridge, and the lateral surfaces, in old specimens, are scarcely perceptible; so that in the exterior circumference the margin of each joint is nearly triangular. At the interior truncated point it is excavated, having in the centre a projecting pointed process, on each side of which another excavation exists, behind which the subtriangular perforated ridge is placed in a slanting transverse direction. At the lower surface a ridge also exists of a subtriangular figure, all the angles are drawn in, and hence the joint has here again a convex form. The scapulæ evidently have lost all their analogy to the *Apiocrinites*, and point out clearly in their formation a transition of organization to the next genus.

On the five scapulæ rest the ten first arm joints (PL. II. 1. and 2.) two of them articulating to each scapula, viz. one on either slope of its superior angular ridge, the outer circumference of each arm joint forms a parallelogram contracted and drawn in at the angles, and hence has not unfrequently in young specimens a tubercular elevation.

To the first arm joint succeed several thinner joints, externally oblong, straight on the lateral surfaces, and nearly flat on the upper and lower surfaces; they are of a horse-shoe shape, and provided with tentacula on alternate sides. Their number varies from six to eight, according to the age of the individual.

The following joints which I should feel inclined to call those of THE FINGERS (PL. II. fig. 1.) have sloping surfaces, and thin off on the opposite

sides in the alternate joints, so that the line of junction in which they overlay each other, becomes an acutely angular zigzag, and they are thus, as it were, dovetailed together; at the same time they shorten their points, not reaching much beyond the middle of the width occupied by the series rising from the same arm joints, this shortening continues until the disposition of the parts at length produce a regular division, extending in a crenated line through the middle of each series, thus giving two joints instead of one to each arm, now properly called fingers, and consequently 20 joints to the whole circumference.

Each of these finger joints is of a semi-horse-shoe shape, and presents externally a tubercular convexity towards the points of its dovetailed insertion, in order to allow greater freedom and ease of motion to the contiguous joints.

Each of the joints sends off laterally a **TENTACULUM** (PL. II. fig. 2.) formed of a series of minute depressed horse-shoe shaped joints, tapering to a point. Like the finger joints, the approaching sides of the alternate tentacula are insinuated or dove-tailed into each other, whence a sort of double serrated edge appears. When the fingers are folded up, in which position the figure of this part bears the nearest resemblance to that of a lily, the tentacula are all folded together in the centre, and arranged in an angle with their points upwards, thus forming a conical fasciculus.

Having thus described the appearance and character of the joints, I shall proceed to a general survey of the abdominal cavity containing the viscera (PL. II. fig. 3.) which is formed by the pelvis, costæ, and scapulæ. In this species it is not of a funnel-shaped figure as in *Apiocrinites*, but rather has the form of a much depressed urn, being widest where the first costæ are provided with the lip-like processes, then becoming saucer-shaped, and opening at the bottom in a pentagonal aperture between the interior truncated points of the pelvis conducting into the alimentary canal. There also exist two rows of orifices in the cavity, formed by the two series of costæ, and the scapulæ, and first arm joints, as noticed when describing *Apiocrinites rotundus*. If we may judge by analogy, and from a representation in **HOFER's** account of the **Encrinite**, (t. ix. fig. 13.) we may with considerable probability conjecture that this abdominal cavity was also closed by an integument protected by numerous plates, having in its centre the aperture of the mouth, and spreading over the inner cavity of the arms, fingers, and tentacula, similar to that

which I shall demonstrate when speaking of the genus *Pentacrinites*. A fine specimen in my possession, showing the double serrated edge of the tentacula, proves this assertion, since it exhibits a similarly formed margin to that which marks the adhesion of the plated integument in *Pentacrinus Caput Medusæ*.

MR. PARKINSON calculates the number of joints forming the superior portion of this animal at 26,680, which would increase most surprisingly, were we to take into account the minute calcareous plates, that are interwoven in the integument covering the abdominal cavity and inner surfaces of the fingers and tentacula, and add them to the former.

As an instance how often a superficial examination may lead men of ability into error, MEINECKEN in *Naturforscher Stueck*, 8. p. 245. advances that the tentacula so regularly arranged in the interior of the lily encrinite, have some affinity to the septa in the orthoceratite, yet that these are formed of many pieces!

The peculiarly fine lily encrinite figured by KNORR, tab. 11. a. was, it is said, purchased (*Naturforscher Stueck* 3.) from the labourers at the limestone quarry at Schrapland, near Halle, by Inspector WILKENS, for 32 groschin, and given to Professor LANGE, who sold it to Baron NIEGART. However in the same publication (*Stueck* 6.) it is stated that it was not bought by WILKENS, but by Mr. VITIGO, at Farrenstadt, near Querfurt, for two dollars, and given to LANGE, who sold it for three louis d'or. If my memory does not misgive me, I think I saw the specimen about twenty years ago in the collection of the *Naturforschenden Gesellschaft*, at Dantzig. Where is it now?

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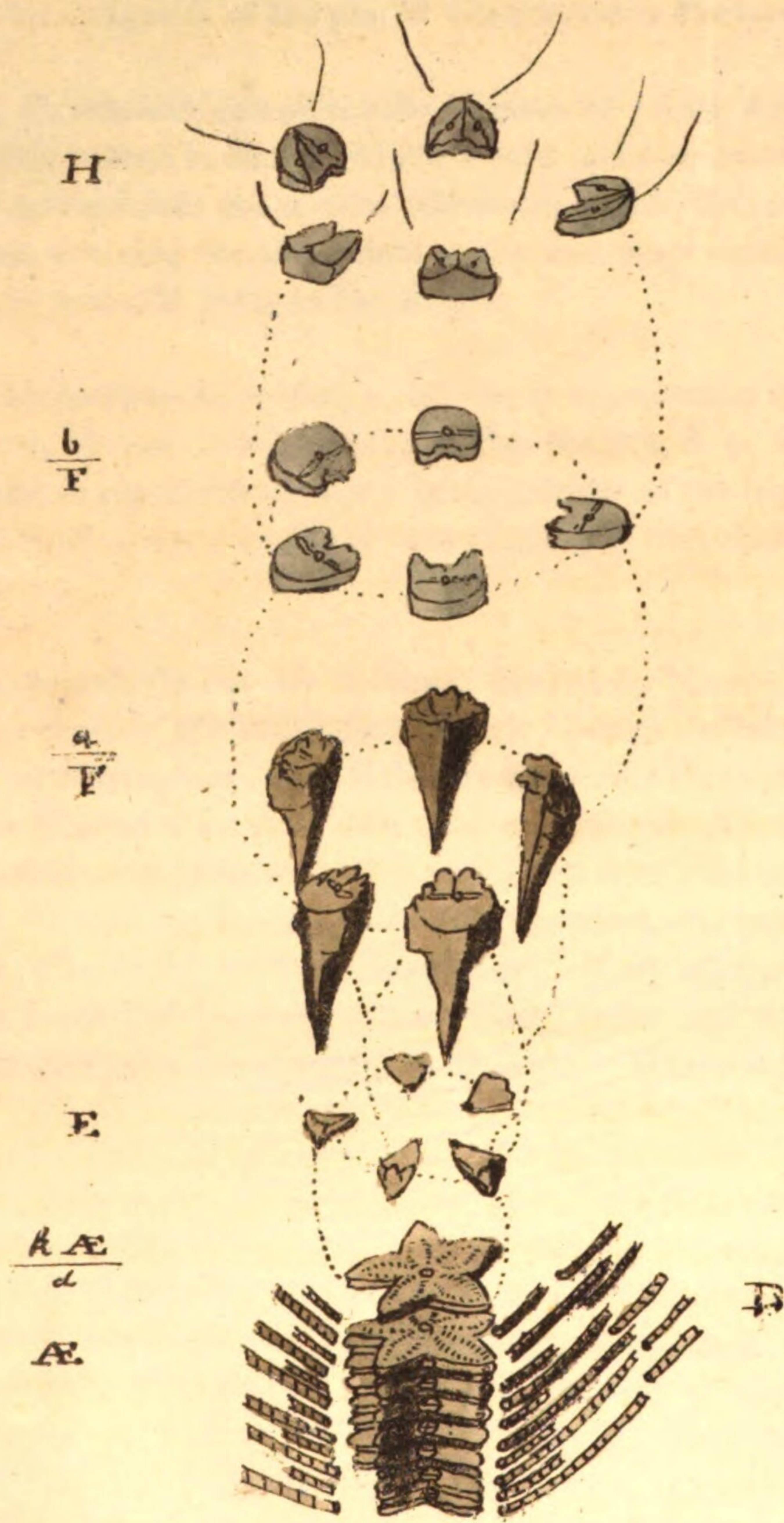
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III. GENUS

PENTACRINITES VEL PENTACRINUS



Miller del.

III. GENUS PENTACRINITES VEL PENTACRINUS.

FIVE ANGLED LILY-SHAPED ANIMAL.

Generic Character.

An animal with a column formed of numerous pentangular joints, articulating by surfaces with pentapetalous semistriated markings. Superior columnar joint supporting a pelvis of five joints, on which five first costals rest succeeded by five second costals and five scapulæ, from which ten arms proceed, having each two hands, composed of several tentaculated fingers.

Column long, having numerous auxiliary side arms.

Base unascertained.

Observation.

The generic name is derived from the five cornered shape of the column. One of its species has occurred in a recent state, and furnishes a clue for the illustration of many facts relative to the crinoidea. The genus **ALECTO** of Dr. **LEACH** approximates the genus **PENTACRINUS** to the **ASTERIÆ** and **COMATULÆ** of M. **LAMARCK**.

There are instances of the column of this genus having sometimes a tetragonal, or hexagonal form, these I consider as monstrous varieties. Of the former figures exist in **TOWNSEND'S** Character of **MOSES**, vol. i. PL. XI. fig. 5. **PARKINSON'S** Org. Rem. vol. II. PL. XIII. fig. 59. **HOFER**, tab. VI. 77. of the latter, **TOWNSEND**, vol. i. PL. XI. fig. 2. **BRUCKMAN'S** Thesaurus Subter. Duc. Brunsw. p. i. Cap. IX. p. 66.

I. SPE. PENTACRINITES VEL PENTACRINUS CAPUT MEDUSÆ.**MEDUSA'S HEAD FIVE ANGLED LILY-SHAPED ANIMAL.***Specific Character.*

A Crinoidal animal having a column formed of numerous pentangular joints, articulating by surfaces with pentapetalous ovate striated markings; five auxiliary side arms formed of round joints, proceeding from the column at intervals. Superior columnar joints supporting a pelvis of five plates, to which the first costals, second costals, and scapulæ, succeed, from which ten arms proceed, each supporting two hands, subdividing into three fingers.

Lower extremity or base unknown.

Reference and Synonymes.

Encrinus Caput Medusæ, LAMARCK.

Isis asteria, LIN.

WHITEHURST.—Inquiry into the original State and Formation of the Earth, **PL. VII. fig. 2.**

PARKINSON'S Organic Remains, vol. II. PL. XVII. fig. 6. to 8. PL. XIX. fig. 1.

Locality.

The few RECENT INDIVIDUALS that have hitherto occurred, have been found in the sea near the Islands of Barbadoes (Dr. HUNTER's specimen) Nevis; (J. TOBIN's, Esq. specimen) and at Martinique (the Paris specimen). Those which have been brought to Europe are now preserved in the British Museum, which has purchased the specimen of the late J. TOBIN, Esq.; at Surgeon's Hall; the Geological Society; the Hunterian Museum, at Glasgow; and the Museum of Paris.

The FOSSIL REMAINS of this species occur in the lyas near Bristol, at Keynsham, Hengrove, &c.

Description.

Through the favour of WM. CLAYFIELD, Esq. I have been enabled to examine the fine specimen once in the possession of the late JAMES (not JOHN as stated erroneously page 11.) TOBIN, Esq. In the drawing it up from the bottom of the sea near the Island of Nevis, in the West Indies, the animal has clearly been broken off, leaving its posterior portion behind; thus we have lost the chance of ascertaining the fact, whether it adhered by a fixed base or had a locomotive power. The same accident has befallen the other recent individuals that have been mentioned when speaking of the locality of this species. However, judging from its analogy to the encrinurus moniliformis, from its long column, numerous auxiliary side arms, and the associated manner in which groups of the following species are sometimes found preserved on the surface of a single slab, with the columns all tending towards the same point, as if issuing from a common base, I conceive that this species also adhered by a base to extraneous matter. This idea gains some further ground, from all the recent specimens hitherto found having broken abruptly off in the endeavour to remove them, as not being able to free themselves from the points of adhesion, which certainly would have been the case, had the animal possessed a locomotive power. This inference acquires additional confirmation from the observations made by the late J. TOBIN, Esq. on another specimen, viz.—“Some years ago I was in possession of a larger pentacrinite, which was brought to me so fresh out of the sea that at the bottom (where it plainly appeared to have been broken off from the rock to which it was fixed) the blood* was actually oozing from the vertebræ. This specimen I endeavoured to preserve, but it was totally destroyed by the ants, who eat every cartilage, so that it fell to pieces.”

I cannot admit the assertion of WALCH, that the pentacrinite is an animal crawling along the bottom of the sea; but conceive it to have generally stood more or less erect in its watery element, yielding to the fury of the storm by bending down, and adhering for additional security with its side arms to extraneous matter, or closing them to the column, and thus offering the least surface possible to the element. The latter is the most probable idea, since I have

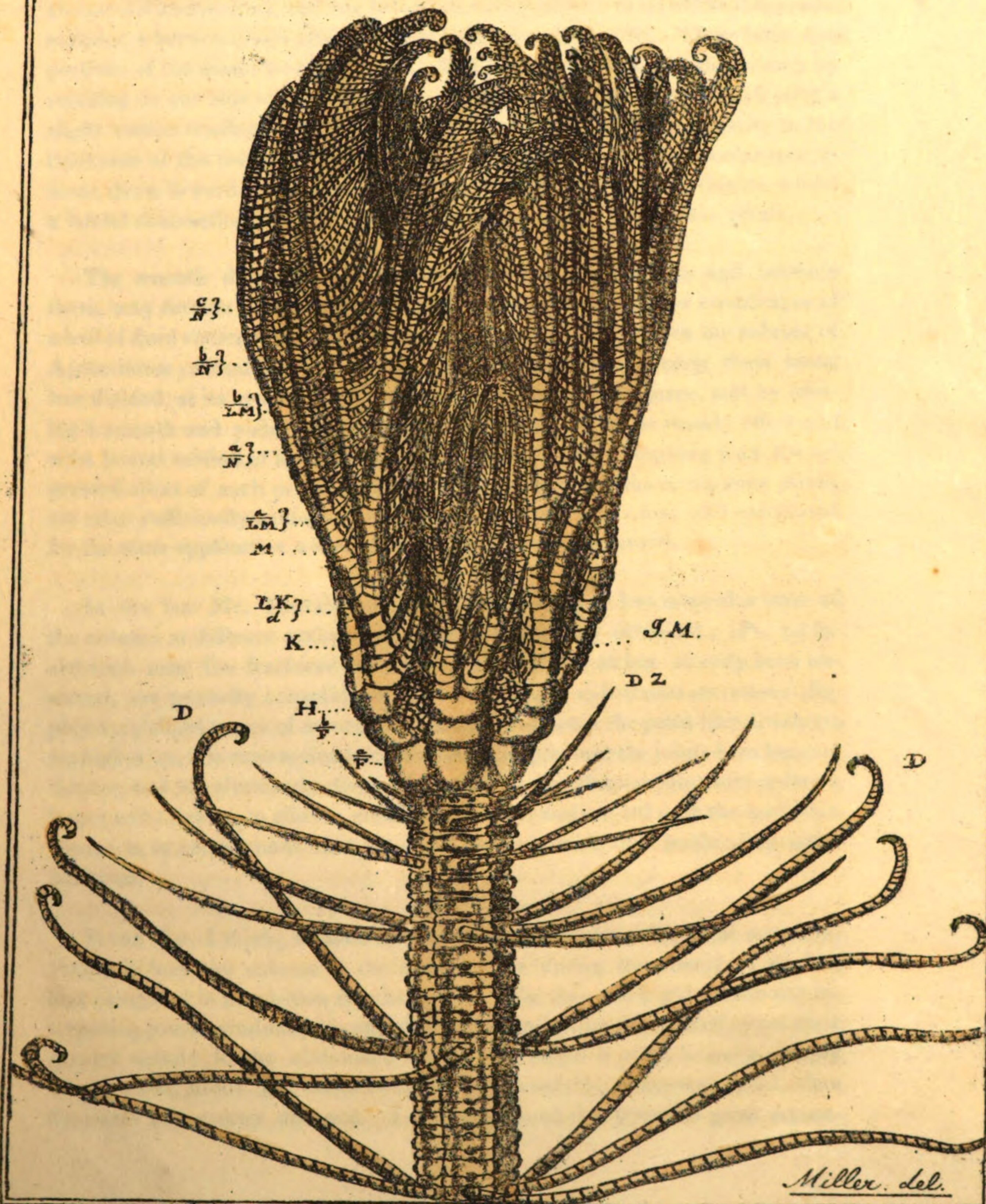
* The fluid in the alimentary canal.

frequently met with specimens in that state, but as yet have never seen any side arms clasping round extraneous matter.

The COLUMN. (PL. I and PL. II. fig. 24. and 26.) The place where the late J. TOBIN'S, Esq. specimen broke off, was in a part of the column where its joints had acquired a degree of maturity, and the fracture goes slantingly through several of them, thereby demonstrating the small quantity of membrane intervening between them, its tenacity, and also the thinness of the exterior integument that surrounds the joints, which is now so dried up as to be almost imperceptible, being of a pale yellow, and intimately connected with the calcareous laminar secreted matter forming them. As the column is not broken in such a manner as to afford a correct idea of the adhering surface of the joints, I must refer for this point to the fossil remains of this species occurring in the lyas. The alimentary canal and its investing membrane are very small. The shape of the column being pentangular, and more or less indented between the five salient angles. (PL. II. fig. 24. and 26.) We trace on the inferior and superior surface of each columnar joint five subovate petal-like figures, marked by elevated ridges radiating round the margin of each of them, the interior of each of these five petal-like figures forms an oblong, ovate, smooth space, surrounded by the marginal radii, opening by a narrow groove at the inner end, which is the most pointed, into the alimentary canal. On joints not fully formed there is also a depression proceeding from the alimentary canal, between the marginal radii surrounding the sides of the contiguous petal-like division, to a smooth space beyond them, filling up the more or less indented, and frequently contracted, intervals between them. If we consider this construction in an early state of growth, when the joints are very thin and muscular, and the calcareous secretion is only commencing, and hence follow the operation of nature, we may suppose that the calcareous deposit first formed round the alimentary canal, in the space occupied by the five petal-like divisions and their marginal radii, and thus continues to increase till the joint has acquired a thickness consistent with the proportions and size of the animal. The space between the five petal-like divisions continues muscular a considerable time longer, and begins only at a later period, and very gradually, to secrete calcareous matter to strengthen the deposit round the alimentary canal, and to interpose thin layers to keep apart the petal-like divisions. The thin muscular integument investing the alimentary canal, probably forms a sphincter at the junction of each two joints, dividing here into ten conspicuous portions or muscular integuments, one extending to each of the spaces between

PENTACRINUS. CAPUT MEDUSÆ

PL. I.



the petal-like divisions, and one to the inner areas of each petal where it spreads, insinuates between, and attaches itself to the marginal radii. These latter five portions of the muscular integument, effect the lateral motion of the column by relaxing on one side and drawing in on the other, thus allowing to each joint a slight motion tending to bend the column in a degree equal in quantity to the thickness of the marginal radii, the other five portions of the muscular integument, draw inwards the muscular space between the petal-like divisions, whilst a lateral contraction is effected from those investing the areas of the petals.

The smooth depressed space within the petal-like divisions and between them, may furnish us with a reason why in the pentacrinite, the contrivance of a ball of fluid enclosed between two concave cups, as noticed in the column of *Apiocrinites rotundus* is done away; since the muscle covering them being less divided at its central junction, can exercise a superior force, and by offering a smooth and yielding surface to the joints, can more readily effect and aid a lateral motion of the column. The concave spaces resulting from the depressed areas of each petal, and thus included between the contiguous joints, are also sufficiently analogous to those intervertebral cavities, and calculated for the same application where circular motion is not required.

In the late Mr. TOBIN'S specimens, the greater or less muscular state of the column at different periods of growth is beautifully exhibited; (PL. I.) for although near the fractured end, the joints (which, as has already been observed, are partially consolidated, and filled up by calcareous secretions) display very slight traces of muscular contraction between the petal-like divisions; yet higher up, this contraction becomes very conspicuous, the joints here become thinner, and are alternately disposed, a smaller and thinner joint succeeding a larger and thicker, to allow a greater freedom of motion, till near the apex this change is so conspicuous that the small ones resemble thin leather-like interpositions.

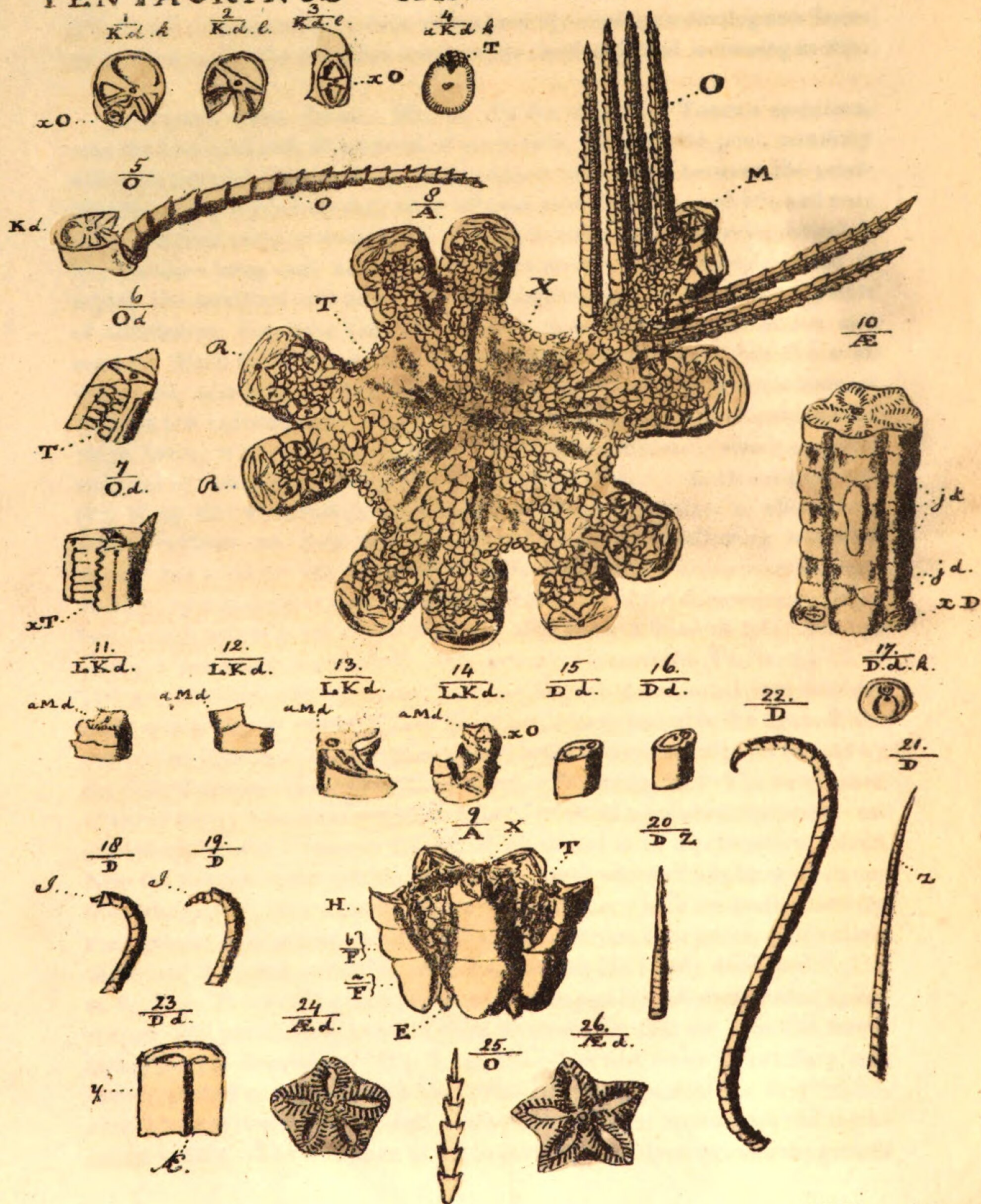
It can also, I think, be asserted from this appearance, with great certainty, that it is here the column of the animal grew during the energy of its life, and elongated in proportion to other parts. The thin and highly muscular interposing joints, gradually became thicker, being favourably placed, from their greater vicinity to the abdominal cavity, to receive a more copious supply of nourishing fluids and calcareous matter through the alimentary canal, than the joints at a greater distance. I also apprehend that from the great muscu-

larity of the column near the pelvis, we may readily admit a continuing new formation of joints, by the muscular integuments developing and increasing in size.

AUXILIARY SIDE ARMS. (PL. I.) In the late Mr. TOBIN's specimen, near the fractured end, at intervals of every 15th, 14th, or 12th joint, auxiliary side arms proceed from each of the five spaces intervening between the petal-like divisions; further up they come off from every 8th, 6th, and 4th, and near the pelvis from every second joint. The intervening space between the petal-like divisions being only near the centre calcareous, is peculiarly adapted to supply the auxiliary side arms with nourishment, and to afford them points of attachment, they have here also a more convenient space for action and motion. Each of the columnar joints from which they proceed has five oval, transverse, and slightly concave impressions, surrounded by a rim sometimes having a few radiating striæ. Across the greatest diameter of the elliptic area is a ridge, having in its centre a perforation admitting the nourishing vessel, probably supplied by vessels proceeding from the alimentary canal. Each auxiliary arm (PL. II. fig. 22.) when full grown is formed by about forty joints, of which those near the column are more or less oval and thinner, the following becoming thicker and rounder, but decreasing in size, their surface slants with an angle of about twenty degrees from the perpendicular line of the column, admitting a free motion upwards (on which side they also show a kind of fold) but opposing a movement downwards. The articulating surfaces (PL. II. fig. 15. to 17.) are surrounded by an elevated rim, the interior is excavated into two circular concavities of unequal size, so disposed as to resemble the figure 8. the two circles forming it, being separated by a small transverse ridge perforated by the central passage of the nourishing vessel. (PL. II. fig. 23.) The termination of the auxiliary side arms is a conic hooked joint, of a polished, greenish, enameled appearance; whereas the rest of the animal is of a pale yellow colour. Near the summit of the column, about the fourth series of auxiliary side arms from the pelvis, they become shorter and thinner; here evidently showing their greater muscularity, bend very slightly, and have their joints, particularly those near the point (which as yet is not hooked) but faintly developed. (PL. II. fig. 21.) Those of the second series from the summit, are short, round, spine-shaped, and particularly near the point so muscular, that not even the terminating joint is discernible. (PL. 2. fig. 20.) The first series of auxiliary side arms (inserted on a joint which the lower protruding part of the first costals almost touch) is still shorter, and almost resembles in appearance and thickness a bristle. The formation of the lower side arms demonstrates the growth

PENTACRINUS CAPUT MEDUSÆ.

PL. II



Miller del.

of these parts of the animal; another curious fact is also proved by them, namely, that the animal had the power of reproducing them when broken. Thus in the late Mr. TOBIN's, specimen, a joint broken transversely near the summit, is seen to have pushed forth a small hook and three other joints. (PL. II. fig. 18. and 19.) The reproduction takes place from the centre of the old joint, the new formed ones having in their centre the perforation, and as yet appearing very weak. This is a new proof that this perforation serves as a passage to the nourishing vessel, and not a nerve, as many authors have, I believe, suggested.

The PELVIS. (PL. II. fig. 9.) On the first columnar joints rests the pelvis, formed of five nearly cuneiform joints having articulating surfaces probably resembling those of the encrinite. Their five points meet near the alimentary canal, they have each a central ridge above, and as the lower part of their exterior circumference slopes downward to the salient angles of the column, they assume externally a leaf-like appearance.

The FIRST COSTAL JOINTS. (PL. II. fig. 9.) In the five concave spaces formed by the five joints of the pelvis, the first costals are inserted. They slope at the inner truncated edge, thus forming a saucer-shaped cavity leading to the alimentary canal: they have two (although less conspicuous) bevelled and slightly plicated muscular lip-like processes; the central excavation of these, leading to the perforated transverse subtriangular ridge in the concave space at their superior surface, which has a slanting direction downwards toward the exterior, and serves for the insertion of the second costal joint. The exterior circumference is lunated in the upper part, as far as the costals adhere laterally to each other, having on the inferior part a process which projects for a short distance into the space between the angles of the column, and has a semi-conical figure.

The SECOND COSTAL JOINTS. (PL. II. fig. 9.) The figure of these joints is that of a horse-shoe, having in the interior an excavated truncated termination. The exterior circumference is semicircular, and their lateral edges do not adhere to each other, but are united by the integuments covering the abdominal cavity.

The SCAPULÆ (PL. II. fig. 9.) rest on the second costal joints, are of a horse-shoe figure, and adhere laterally to each other only by the integument mentioned above. At the superior surface, a central ridge extends with a

pointed termination to the interior truncated and excavated point, forming two slanting sides for the adhesion of the first arm joint. Each of these are traversed by a perforated ridge running in a slanting direction from the interior to the exterior point.

The ARMS.—The ten arms proceeding from the five scapulæ, (two from each) are each formed of five joints nearly of an horse-shoe figure, sending off from their alternate sides the tentacula. The superior surface of the first arm joint (PL. II. fig. 4.) and the inferior of the second, are subconcave, perforated in the centre, smooth, with fine radiating ridges at the circumference, and want the transverse subtriangular ridge which exists in the following arm and finger joints. In these it traverses the superior surfaces (PL. II. fig. 1. to 3.) in an angle from near the place where the tentaculum sets off to the opposite exterior circumference, and at the inferior surface in an opposite direction to the former. On the inside the joint is excavated in the centre in a sharp angle, it is thicker on the side which sends off the tentacula, being there cut in an obliquely transverse section, of which the lower portion shows a ridge, the mark of articulation, whilst the upper forms a slender lamina. The projecting point on the other side is slantingly cut off to permit room for the action of the tentaculum from the joints below it. There are also several irregular rugæ on the articulating surfaces, serving as points of adhesion to the muscular integument.

The upper or sixth joint of the arm (PL. II. fig. 11. to 14.) resembles in figure the scapula; this, and those other joints bearing an analogy to it, I have distinguished by the name of cuneiform joints, from their upper surface possessing two opposite slopes, and, like a wedge, interrupting the further continuing of a series of joints, and rendering it dichotomous.

The cuneiform joints never send off a tentaculum, and to obviate the interruption or vacuity thus occasioned in the beautiful net-like apparatus displayed when the hands and fingers with their tentacula are expanded, the number of joints below the cuneiform one generally varies in the hands; thus affording an opportunity for the insinuation of the tentaculum arising from the neighbouring hand, into the vacant place if required.

The HAND and FINGERS. (PL. I.) These are twenty in number, two proceeding from the cuneiform joint of each arm. Each series proceeds through about eight or nine joints, and then by means of another cuneiform joint gives

rise to a further subdivision. This I shall call the first cuneiform joint of the hand, designating the lateral branch which proceeds from it, as the first finger, and the continuation of the main series of joints, as the second series of the hand joints. This second series, consisting of about twelve joints, terminates by a cuneiform joint (the second cuneiform joint of the hand) which gives rise to the second and third finger. Each of the fingers with its tentacula, bears a close resemblance to the vane of a quill, becoming at its superior extremity highly muscular.

The JOINTS of the HAND and FINGERS exactly resemble those of the arms, only that they become gradually smaller as they approach to the point of the fingers, and send off, like them, tentacula from the alternate sides.

The TENTACULA. (PL. II. fig. 5. to 7. and 25.) The tentacular series of the arms, hands, and fingers, near the cuneiform joints in full grown specimens, consist of about twenty joints gradually tapering to a point, but decreasing in number and size near the apex of the finger, where they are formed of only one or two joints terminating in muscular undeveloped points; proofs of their continuing growth through the whole life of the animal, and of their possessing a greater power of action at these extremities. The joints of the tentacula are nearly horse-shoe shaped, having the side where their series folds upwards somewhat compressed, and less protruding.

The circumference of each tentacular joint, but particularly of those towards the point of a series (PL. II. fig. 5. and 25.) is smaller, or contracted near the base; an admirable contrivance to assist motion, and also contributing much to give this part of the animal an elegant and finished appearance. The articulating surfaces present transverse ridges, pierced in the centre by the canal of the nourishing vessel.

The PLATED INTEGUMENT. (PL. II. fig. 8. and 9.) The sides of the second costal joints and scapulæ are tied together by an integument, strengthened and protected externally by numerous calcareous angular plates, which extend over the funnel-shaped abdominal cavity, having in its centre, probably, the minute aperture forming the mouth, which in the present shrivelled state of this part in the late Mr. TOBIN's specimen, it was impossible to ascertain. When the animal was alive, this integument, probably, was capable of having its central part elongated and protruded by the action of its muscles, so as to form a

sort of proboscis for the sucking in of food. It spreads over the sulcated part of the arms, hands, fingers, and tentacula, concealing under it nourishing vessels, which may be sometimes traced spreading into the muscular integuments between the fingers. The arrangement of its calcareous plates is peculiarly elegant in the tentacula (PL. II. fig. 6. and 7.) where they form two series angularly pointed at their inner edge, thus producing a serrated line of insertion between each other. Their minuteness may be conceived from the observation, that from ten to twelve are necessary to cover the excavated canal of a single tentacular joint, which, taking the amount of these, would require about 200 plates for each full grown tentaculum.

I have in vain endeavoured to trace apertures at the terminating points of the fingers and tentacula, although GUETARD alleges, that here orifices existed serving as mouths to the animal for the taking in its food. It appears probable to me that from this assertion M. LAMARCK derived his generic character of *ENCERINUS*. "The branches forming the umbel are filled with polypi in rows."

The late Mr. TOBIN's specimen, is in another point highly instructive. The animal must have suffered material mutilation previously to its having been taken from its marine abode, and hence affords a striking illustration of its power of reproducing lost parts, to which I alluded when speaking of the auxiliary arms; the most surprising instance of this, is, that the animal has reproduced from one of the scapula two new arms (PL. I.) each having its two hands and six fingers, but as yet not an eighth part the size of the full grown ones. They are highly muscular, and prove the gradual developement and formation of the calcareous joints in the manner which I have endeavoured to explain, when speaking of the superior portion of the column and the formation of the auxiliary side arms. The pointed termination of the fingers is coiled, which demonstrates the greater sensibility and flexibility of this part during the life of the animal. The new formed arms protrude from near the inner concave or channelled margin of the scapula over the central perforation, leaving the rest of its slanting surface covered by a conspicuous yellow brown epidermis. In a few other instances, new formed fingers proceed from the cuneiform joints in different stages of growth, sometimes almost assimilating in size with those whose place they now supply. In one case two joints of a finger have been broken transversely on one side, their parts somewhat displaced, and the fracture healed by new secreted matter. The effects of an injury sustained by the investing membrane of the column, and the consequent irregularity of the

joints affected, is exhibited in one instance (Pl. II. fig. 10.) precisely in the same manner as was before noticed in the *Apiocrinites rotundus*.

COLUMNAR FRAGMENTS, smaller and rather neater than those of the species just described, occur in the oolite at Dundry, the forest marble at Chippenham, and the chalk near Lyme. It remains to be ascertained by the acquisition of perfect specimens, whether these belong to a variety of *P. Caput Medusæ*, or possess peculiar characters sufficient to distinguish them as a new species.

II. SPECIES PENTACRINITES BRIAREUS.

BRIAREAN FIVE-ANGLED LILY-SHAPED ANIMAL.

Specific Character.

A Crinoidal animal, having a column formed of numerous pentagonal joints, alternately larger and smaller, articulating by surfaces with pentapetalous compressed semistriated markings. Five auxiliary arms, formed of much compressed suboval joints, proceeding at intervals from the column. Five joints of the pelvis, supporting five first and five second costal joints, on which the scapulæ affix, from which ten arms proceed, each having two hands formed of numerous fingers, sometimes amounting to sixteen.

Base unascertained.

Reference and Synonymes.

PARKINSON'S Organic Remains, vol. 2. t. 17. fig. 15. to 17. t. 18. fig. 1. to 3.
KNORR.—Recueil de Monumens, Supl. t. 11. 6.

Locality.

In Lyas—at Lyme, Watchet, Keynsham, &c.

Description.

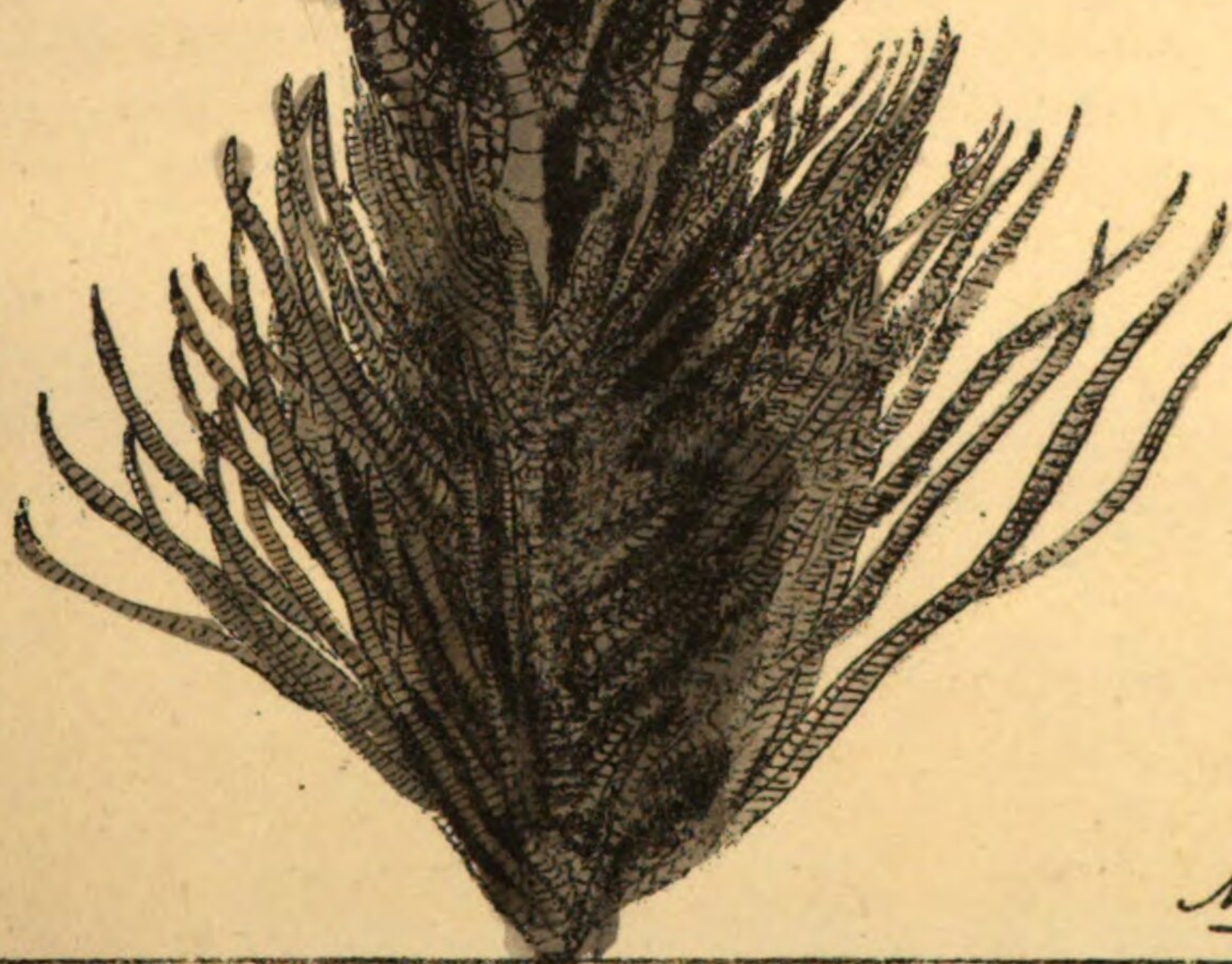
In general construction and muscular action it resembles the former species, but differs materially in many particulars. Its COLUMN (Pl. II. fig. 15. to 21.) grows sometimes to the length of several feet, having its joints in all the specimens which I have seen, alternating, a thinner and smaller one, and a thicker and larger one always succeeding to each other. They articulate by pentapetalous striated surfaces, which are not of an ovate (as in *P. Caput Medusæ*) but an almost linear form (Pl. II. fig. 19. to 20.) the space between them being

PENTACRINITES BRIAREUS

PL. I.

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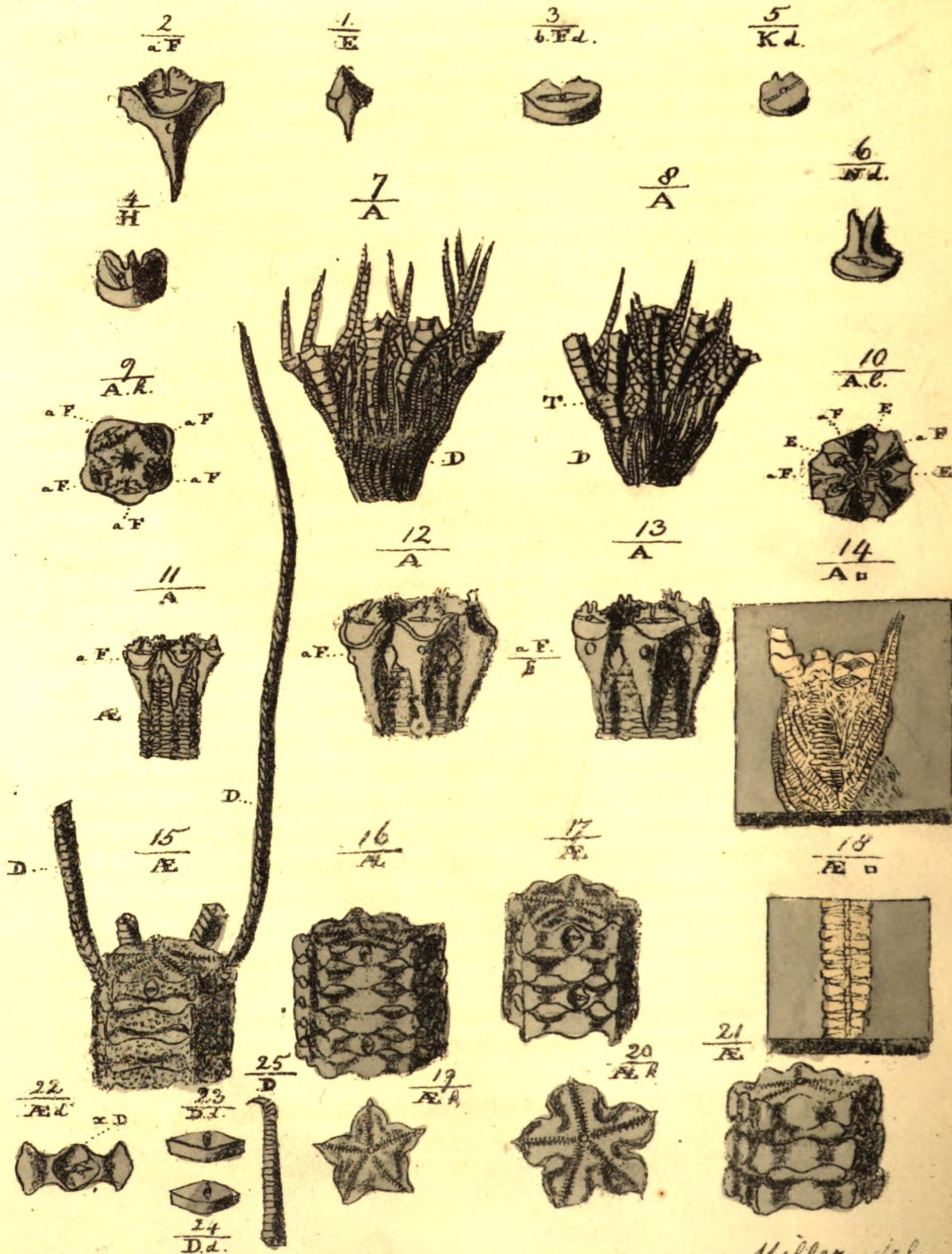


Miller del.

PENTACRINITES

BRIAREUS

PL. II.



in consequence greater, more muscular, and more liable to contraction, the effect produced by this is (PL. II. fig. 16. 17. and 21.) that the larger joints are somewhat flat at their exterior circumference, rounded near the articulating rim, and slightly convex; whereas the smaller and thinner joints are compressed, and frequently so much so, as hardly to be distinguishable, whilst the corners to which the striated petal-shaped markings extend are swollen and convex above and below. The line of articulation between every two joints becomes, from this disposition of convex and concave surfaces, elegantly waved. The angles of the column are sharper than in the former species, and the thicker joints are sometimes externally slightly tuberculated, the results of muscular contraction.

AUXILIARY SIDE ARMS. (PL. II. fig. 15.) Near the summit of the column auxiliary side arms set off from every thicker joint; (PL. II. fig. 11.) hence, from their excessive number, forming a marked and peculiar feature, whence this species derives its name; farther down, the side arms proceed from every second thicker joint, and the intervening number of joints increases to three or four of each kind thicker and thinner towards the lower extremity. (PL. II. fig. 16.) They are also inserted in the intervening space between the angles of the larger the elliptic mark of insertion is not transverse, (PL. II. fig. 22.) but placed with its greatest diameter perpendicularly, thereby gaining a greater power of adhesion: its circumference, by contraction, sometimes becoming slightly lozenge shaped, having a transverse perforated ridge across the shortest diameter. The joints of the side arms (PL. II. fig. 23. and 24.) are thin, much compressed, sub-elliptic, or rather lozenge-shaped, having both extremities sharply ridged, they gradually decrease in size, till at the end of the series they terminate in a point. (PL. II. fig. 15. and 25.) As they proceed from the column they alter their position, their longest diameter becoming horizontal, and not perpendicular as at the insertion. The length of the auxiliary side arms when fully grown, and their frequent occurrence, give a singularly bushy appearance to the column. They shorten as they approximate to the summit of the column, where their joints become less developed. When the animal is contracted (PL. II. fig. 7.) the superior auxiliary side arms overlay the pelvis, and reach with their slender points to the fifth arm joint. In this case they all envelope the column in a close fasciculus, and thus make it appear thick and undefined.

The **PELVIS** (PL. II. fig. 1. 9. and 10.) is of the same formation as in the former species.

The FIRST COSTAL JOINTS (PL. II. fig. 2. 9. to 14.) are externally more muscular, reaching downwards over a greater number of columnar joints, and tapering to a point. They have each a longitudinal central ridge, which is more clearly exhibited when in a contracted state, when also near the upper portion between the ridge and the pointed angles of the pelvis, a tubercle appears on either side. (PL. II. fig. 13.) It here suggests itself to me that the elongation of the first costals in the pentacrinites is intended to strengthen the column in this place, where being most muscular, it is most yielding, and therefore requires strong abutments to bear the weight of the arms and fingers, and sustain their various motions.

The SECOND COSTAL (PL. II. fig. 3.) the scapulæ (PL. II. fig. 4. the JOINTS OF THE ARMS (PL. II. fig. 5.) HANDS AND FINGERS (PL. II. fig. 6.) are formed in a similar manner to those of *P. Caput Medusæ*.

The number of FINGERS in the smallest and youngest specimens (PL. I. fig. 2.) I have seen, amounted to four; the length of the hands from the cuneiform arm joint being scarcely an inch, and of the whole animal not above two inches. These fingers showed, like those belonging to the reproduced arms on the late Mr. TOBIN's specimen, a certain immaturity. I have traced the increase of the number of fingers to five and eight, and ascertained that in full grown specimens the number amounts to sixteen, when each hand was about six inches long. (PL. I. fig. 1.)

After a careful examination, I succeeded in detecting traces of the PLATED INTEGUMENT covering the viscera, between the costal joints, (PL. II. fig. 8.) and scapulæ, as also where it covers the channel of the tentacula. I was much gratified when, on a subsequent examination of Mr. PARKINSON's plate, (T. XVIII. fig. 2.) I found that his draughtsman (to whose talent of making faithful and correct delineations I cannot omit to give my highest testimony,) had also represented the plates of the integument between the costals and scapulæ.

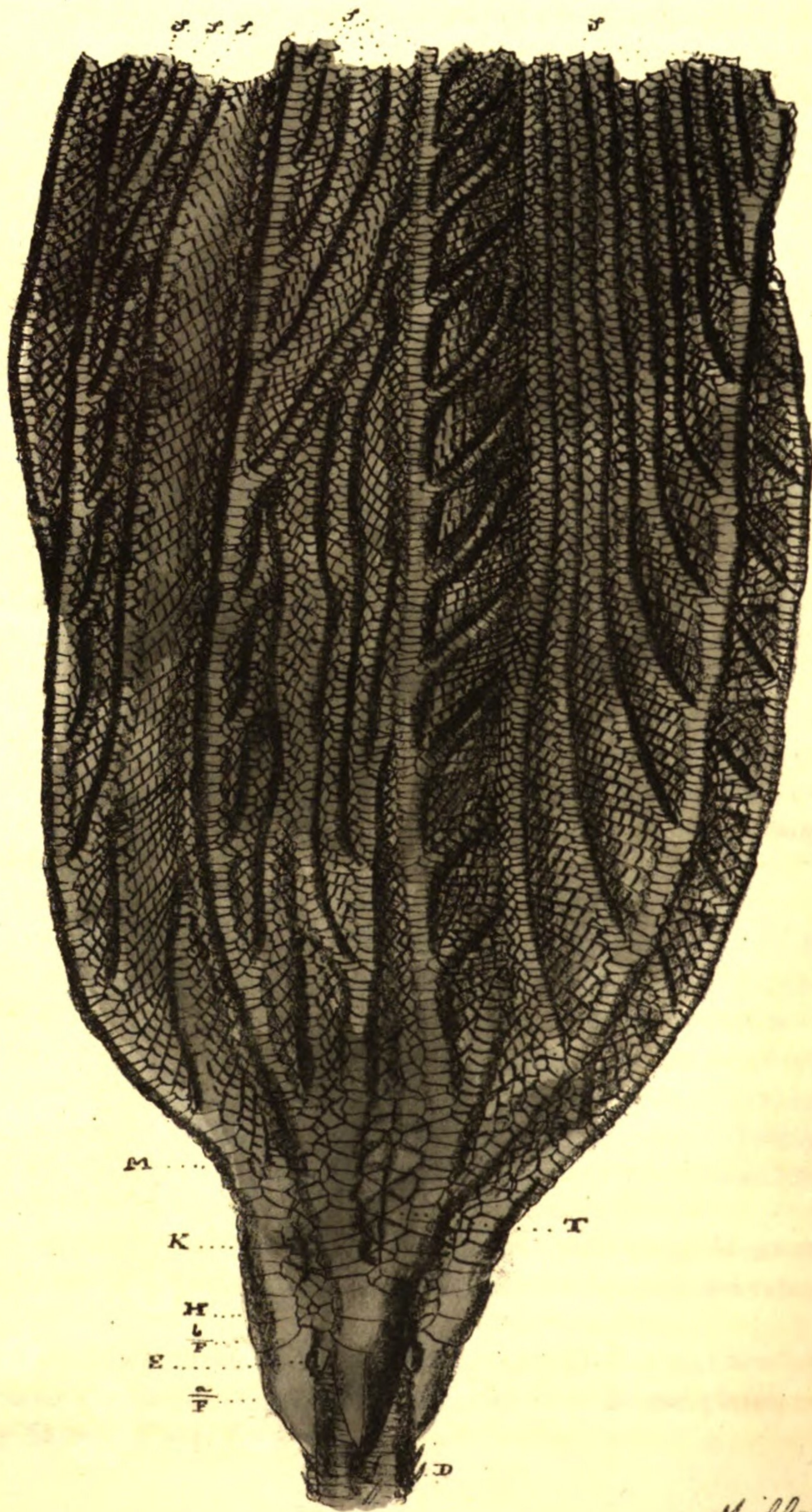
Sections of the first Costals (PL. II. fig. 14.) frequently demonstrate a gradual increase from external laminæ, as noticed in *Apiocrinites rotundus*.

I apprehend that perfect and full grown animals of this and the following species, must surpass all others in their number of joints and plates, not even excepting *Euryale Caput Medusæ*.



PENTACRINITES SUBANGULARIS

PL. I.



Miller del.

III. SPECIES. PENTACRINITES SUBANGULARIS.

SUBROTUND FIVE ANGLED LILY-SHAPED ANIMAL.

Specific Character.

A Crinoidal animal having a column formed of numerous slightly pentagonal joints, alternately thicker and thinner, articulating by surfaces with pentapetalous semistriated markings, each petal being ovate, surrounded by an elevated ridge; five round auxiliary side arms proceeding at intervals from the thicker joints, and alternately approaching the opposite sides of the space between the angles of the column, so as to form double series. Pelvis, first and second costal, and scapulæ in successive series formed of five joints; from which ten arms proceed, having two hands provided with numerous fingers, amounting in each if the animal is fully grown, to about sixteen.

Reference and Synonymes.

PARKINSON'S Org. Rem. vol. II. PL. XIII. fig. 48. to 51. and 60.

KNORR.—Recueil de Monumens, Supl. t. 11. c.

Briefe aus der Schweiz geschrieben im Jare 1763. t. 2. fig. h. and t. 6.

Locality.

In Lyas—at Lyme, in Dorsetshire. In black Slate, in the kingdom of Wurtemberg, in Germany.

Description.

The COLUMN (PL. II. fig. 1. to 3.) of this animal is formed of alternately thicker and thinner joints. Each of the five petal-like markings on the surface, has a subovate form, and is surrounded by an elevated ridge, rendering the exterior circumference subrotund.

AUXILIARY SIDE ARMS. (PL. II. fig. 1.) In a specimen in my possession, from the space between each of the angles of every second larger joint of the

column, an auxiliary side arm proceeds, formed of numerous minute round joints, depressed above and below. These side arms have, probably, a greater number of columnar joints intervening, the further they are distant from the pelvis. Their points of insertion are not disposed as in the preceding species, directly over each other, but alternately approach the opposite sides of the space between the angles, so as to form a double series. One or two columnar joints above each point of insertion is grooved, for the purpose of admitting a closer adhesion of the side arms to the column, when the animal is in a state of contraction or rest.

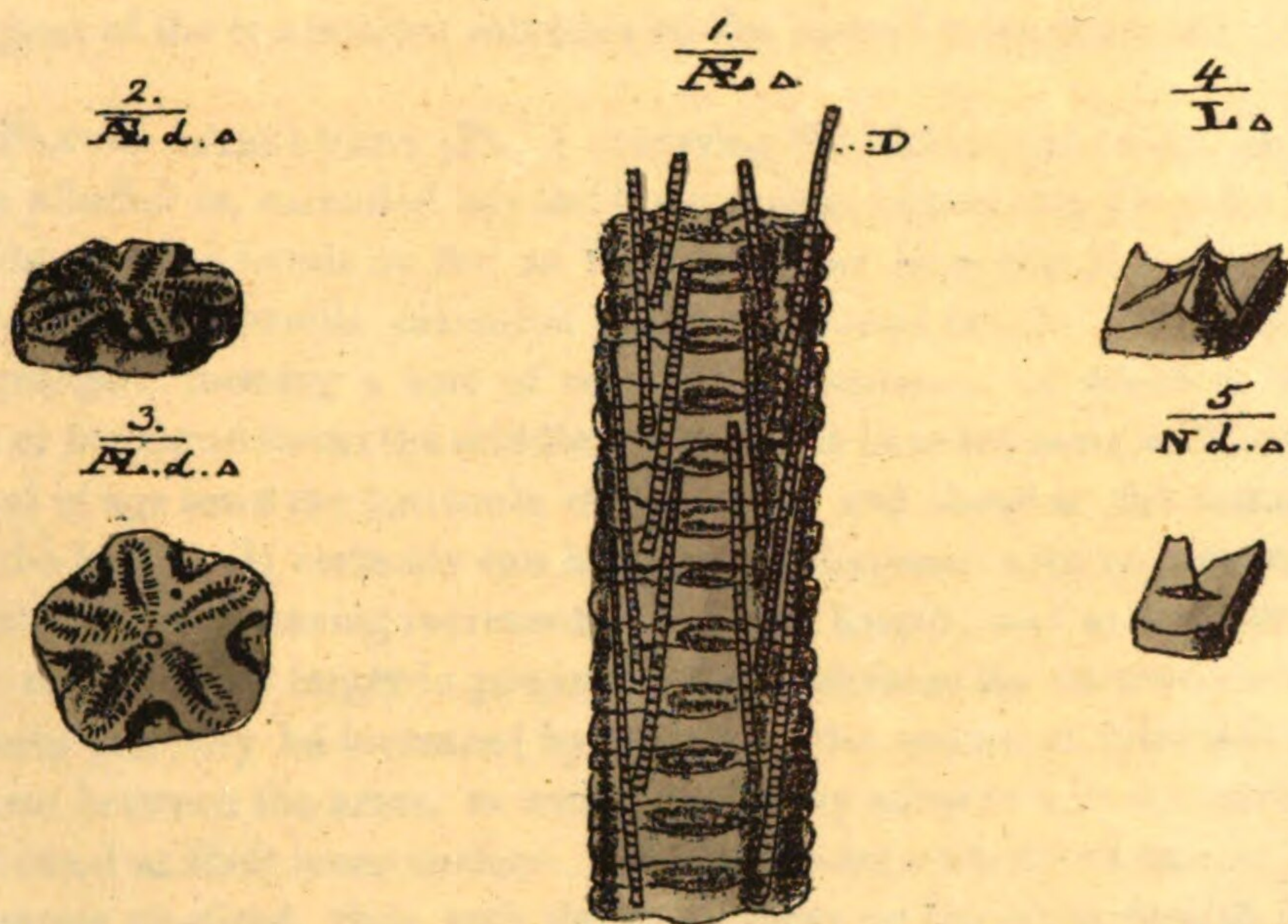
In the *P. Caput Medusæ*, the round side arms near the pelvis are short, and as they lengthen, the distance between the series increases, thereby allowing free motion without any other provision. In *P. Briareus*, they are very numerous and long, but in order that they may divide the space correctly without infringing on the column or creating confusion, they are lozenge-shaped; therefore when folding around it by packing together with the flattened sides towards each other, many will go in a small circumference, and when extended, the longest diameter of the lozenge being horizontal, a greater surface for the purpose of detention is produced. In the present species they are again round, but in more frequent series than in *P. Caput Medusæ*; hence their arrangement in double rows, becomes necessary, and as they occupy more room, and intrude on the angles of the columnar joints, the provision of a groove in those over them, as noticed above, becomes necessary to enable them to adhere closely to the column when contracted.

In a fine specimen of the superior portion of this animal, of an apparently nearly full grown size, which I have had opportunity to examine, the FIRST COSTAL JOINTS (PL. 1.) are acutely angular, and do not overlay so many of the subjacent columnar joints.

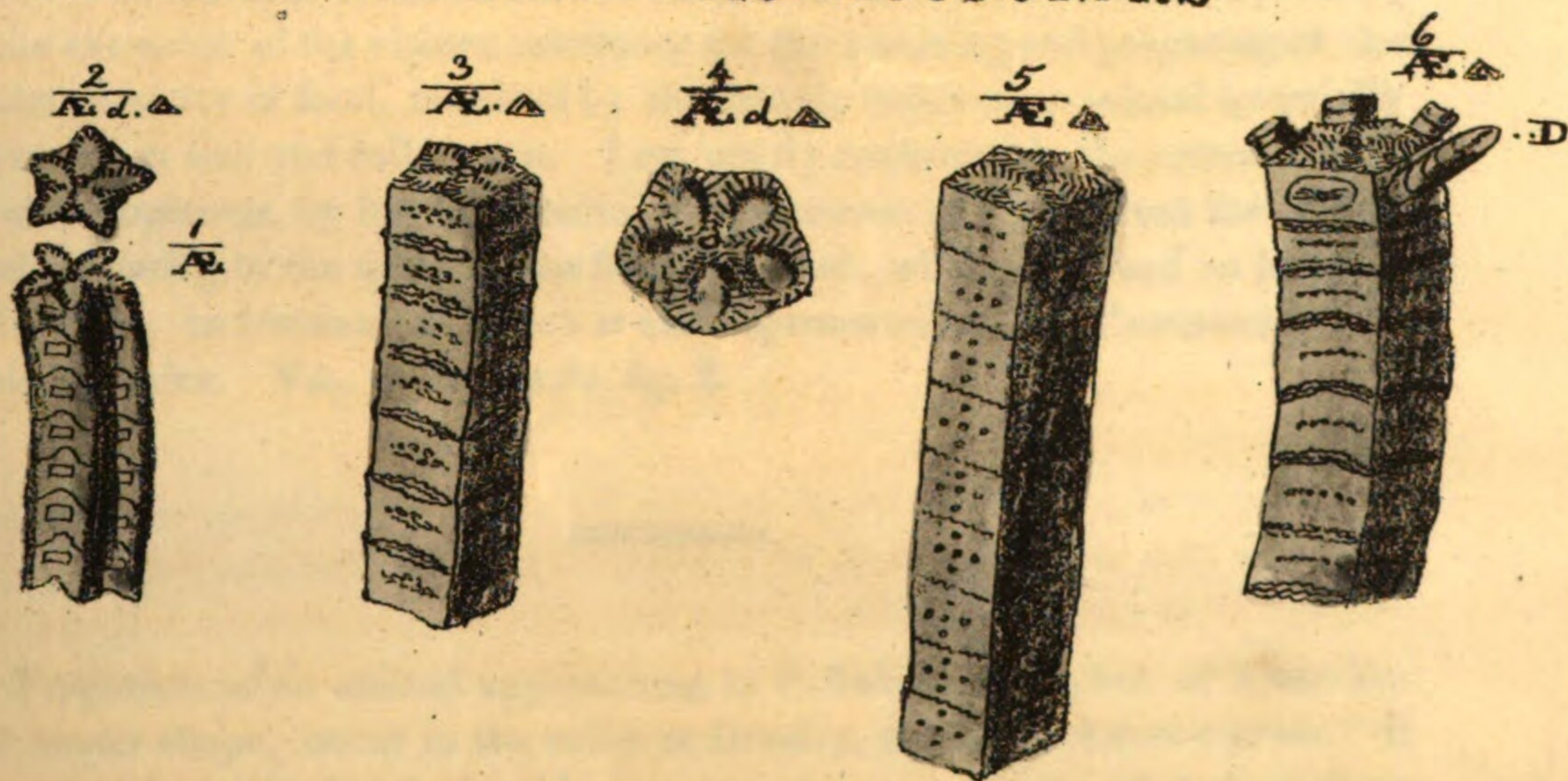
The arms and hands resemble those of the former species, but the tentacula set off rather differently. The first joint of each tentaculum is not only (as in the former species) received into a depression of the finger joint above that from which it proceeds, but also occasions a depression in the base of the third finger joint above it, and from the upper part of which again another tentaculum proceeds, thus producing a scale-like overlaying appearance. As stated before, the specimen from which my observation is taken, demonstrates considerable maturity of growth, and hence shows throughout a close structure, and

PENTACRINITES SUBANGULARIS.

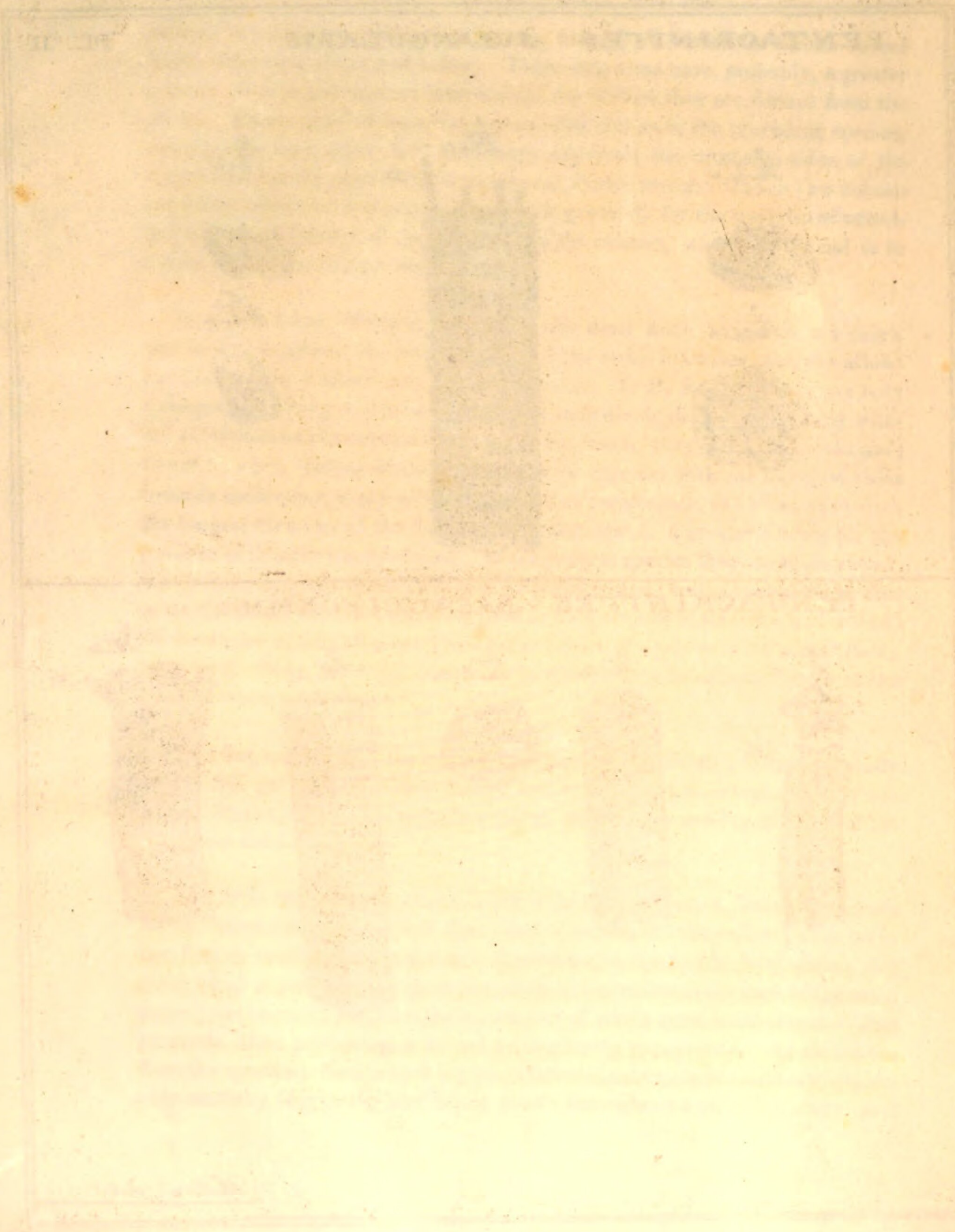
PL. II



PENTACRINITES BASALTIFORMIS



Miller. del



not that freedom of parts observable where room is left for increase. It is, perhaps, owing to this that all the joints of the hand have laterally, where they adhere near each other (PL. II. fig. 4. and 5.) a compressed figure, as also that the first joint of the tentaculum intrudes on the second joint above it.

The PLATED INTEGUMENT (PL. 1.) covering the abdominal cavity, is in the specimen alluded to, extended beyond the scapulæ, connecting the sides of the arm joints and the hands as far as the first finger joint together, hence demonstrating a considerable extension of the abdominal cavity. The plates are neatly arranged, forming a sort of rose-like appearance, of which a minute hexagon or heptagon forms the middle. A question here suggests itself, whether the animal in age loses the tentacula of the arms, and those at the commencement of the hand? It certainly can here readily dispense with an apparatus of detention, its fingers having increased in size and length, and as the costæ and scapulæ do not grow larger in proportion, it is obvious the covered cavity between them can only be increased by extending the points of adhesion of the integument between the arms, to which it already adheres where it covers the grooved canal at their inner surface. By dispensing with the tentacula, which are no longer required, their articulating surfaces on the arms, furnish favourable points for the angular insertion and adhesion of the plates of the integument. The increase of the size of the abdominal cavity is rendered imperious, by the extension of the viscera necessary for the receiving and preparing of the greater quantity of food, required by the organic wants of an animal materially increased in size and full grown. I am nearly confirmed in the correctness of the above opinions, by having detected in a specimen of *P. Briareus* the integuments adhering to the sides of the first arm joint, which also had no longer a tentaculum, an instance of which is also represented in Mr. PARKINSON'S Organic Remains. VOL. II. PL. XVIII. fig. 2.

Fragments of an animal approaching to *P. Subangularis*, but of a smaller and neater shape, occur in the oolite at Dundry, and in the forest marble. It must remain for further favourable opportunities to ascertain what claim these have to a specific distinction, or whether they belong to a variety of present species.

ADDENDA.

Besides the *Pentacrinites* described, I have met with columns and fragments of animals belonging to this genus, but indicating plainly that they have a claim to specific distinction. Not having, however, sufficiently perfect specimens to enable me to draw up a specific character, I shall confine myself to a short description of as much as has come under my observation.

IV. SPECIES. *PENTACRINITES BASALTIFORMIS*.

BASALTIFORM FIVE ANGLED LILY-SHAPED ANIMAL.

Reference and Synonymes.

PARKINSON'S *Org. Rem.* vol. II. tab. 13. fig. 54.

Locality.

In *Lyas*—at *Lyme*, also in the *Chalk* near *Lyme*.

Description.

I am acquainted with the column (see *PL. II.* of *P. Subangularis*, fig. 1. to 6.) alone of this species, which is peculiarly neat and slender, formed invariably of joints of an uniform size and thickness, sending off at intervals from fifteen to twelve (fig. 6.), and probably less near the pelvis, round auxiliary side arms.

In an early state of growth (fig. 2.) when the space between the oval petal-shaped secretions is muscular, they illustrate my views with regard to a gra-

dual deposition of calcareous matter in these places. It forms at this period (fig. 1.) a transverse round ridge, over which the muscular part is drawn in acutely. In a more advanced stage of growth (fig. 4.) the petals increase so much as nearly to efface the intervening space, and hence the crenated line of adhesion between these joints, arising from the insertion into each other of the radii and notches surrounding the petals, may be traced continuously round the circumference, uninterrupted as in younger specimens by intervals where the margin is smooth. The whole joint being at this period calcareous (having only a muscular integument) the column has a smooth pentagonal appearance, with a slight elevation near the junction of every two joints, leaving, however, a trifling ridge between for the action of the small portion of muscle extending to the exterior circumference, over and between the radii of the petal-like formations. The ridge mentioned before has now disappeared, and in its stead we trace a slightly elevated line (fig. 3.) waved conformably to the power exercised on it by contraction of the muscles between the joints. A further contraction (fig. 5.) breaks this line into three or four minute tubercles, and sometimes by lateral contraction produces two other tubercles, one above and one below the line.

I understand, that at Lyme, columns of from four to five feet long occur, belonging to this species.

V. SPECIES. PENTACRINITES TUBERCULATUS.

TUBERCULATED FIVE-ANGLED LILY-SHAPED ANIMAL.

Reference and Synonymes.

PARKINSON'S Organic Remains, vol. II. PL. XVII. fig. 11. (In this figure no tubercles are however expressed). PL. XIX. fig. 2. ?

WHITEHURST'S Inquiry into the Original State and Formation of the Earth. PL. VII. fig. 1. 2.

Locality.

In the Lyas—at Pyrton Passage.

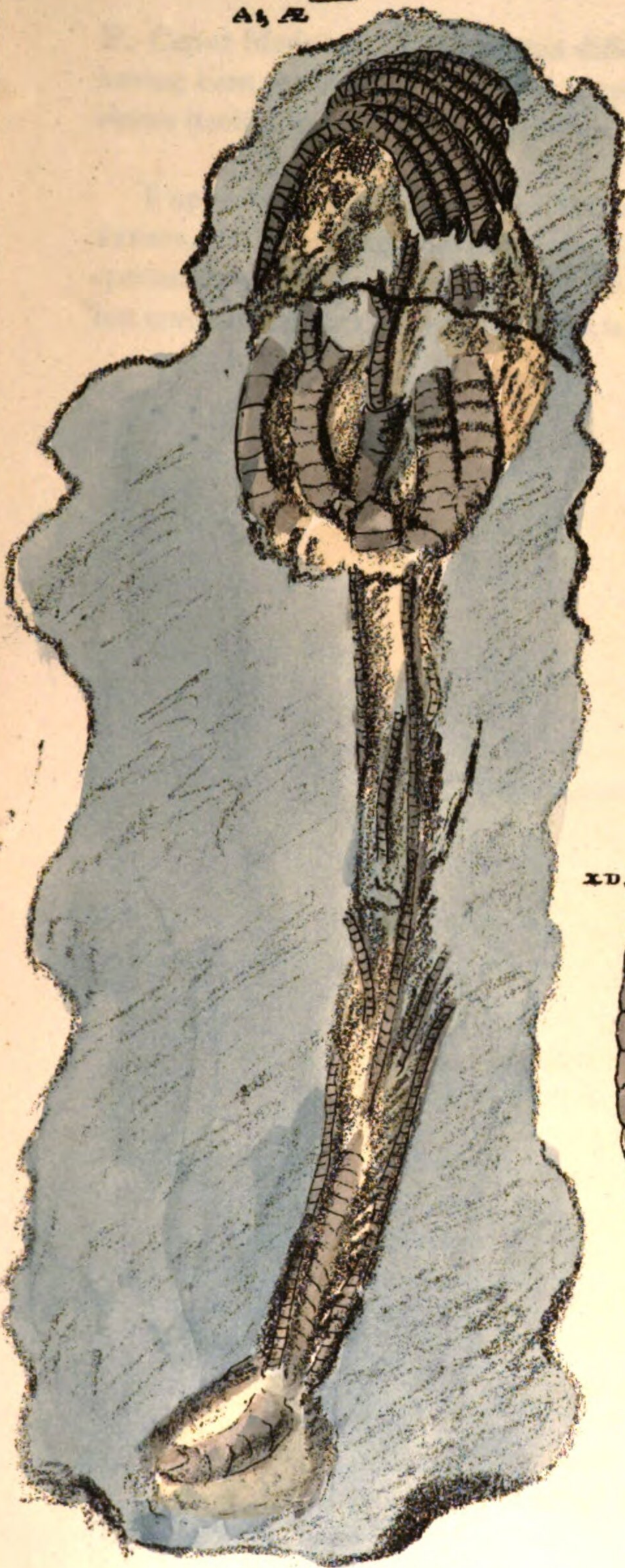
This species appears to be characteristic also of a bed of rubbly lias, near the top of the series constituted by that formation; this bed may be traced from the vale of Belvoir, on the borders of Rutland, along the borders of Leicestershire, to the tunnels of the Grand Union Canal at Husband Bosworth, and at Crick; thence along the confines of Warwickshire and Northamptonshire, by Branston tunnel (on the Oxford Canal) and Shuckborough Park, well known for the abundance of these remains. The line of the Oxford Canal continues in the same stratum, past Wormleighton Tunnel as far as Claydon; (in all the places mentioned it is rich in these fossils), the same bed continues to range round the base of the Cotteswold Hills through Gloucestershire, but its course has not here been so accurately traced.

Description.

I have only seen the column and auxiliary side arms of this species, they are larger than those of any other species, and resemble closely those of

PENTACRINITES TUBERCULATUS

A, $\frac{1}{A}$



$\frac{4}{Dd}$



$\frac{5}{Dd}$



$\frac{2}{A}$



$\frac{6}{Dd}$



$\frac{7}{Dd}$



$\frac{3}{Aa}$



$\frac{0}{Aa}$



V

J. S. Miller. del

PENTACRINITES TUBERCULATUS

Fig. 1.



P. Caput Medusæ. The Column differs in its joints, being thinner, and their having been covered all over with a more conspicuous muscular coat, which shows itself in numerous minute tubercles, the result of its contraction.

I apprehend that the superior extremity figured in WHITEHURST and PARKINSON, as mentioned above, belonged to this species. I also conceive that a specimen in the possession of Mr. G. HAWKER, from the banks of the Severn, but much disfigured by pyrites, appertains to it.

CRINOIDEA SEMIARTICULATA.

Character of the Division.

THE plate-like joints resting on the superior columnar joint, and forming the cap containing the viscera, articulated by transverse processes, having a minute central perforation.

Observation.

Although I am acquainted with but one species strictly possessing the character assigned to it (viz. that which serves as the type for the genus *Potamopecten*) yet I thought it advisable to constitute the division *SEMIARTICULATA*, to mark in a more conspicuous manner the transition from regularly articulating joints to plates adhering only by muscular setæ.

II. Division.

CRINOIDEA SEMIARTICULATA.

Character of the Division.

THE plate-like joints resting on the superior columnar joint, and forming the cup containing the viscera, articulate by transverse processes, having a minute central perforation.

Observation.

Although I am acquainted with but one species strictly possessing the character assigned to it (viz. that which serves me as the type for the genus **Poteriocrinites**) yet I thought it advisable to constitute the division **SEMIARTICULATA**, to mark in a more conspicuous manner the transition from regularly articulating joints to plates adhering only by muscular sutures.

GENERAL INSTRUCTIONS

TO THE MEMBERS OF THE

COMMISSIONERS OF THE

LAND OFFICE

IN THE

STATE OF NEW YORK

AND

THE

LAND OFFICE

OF THE

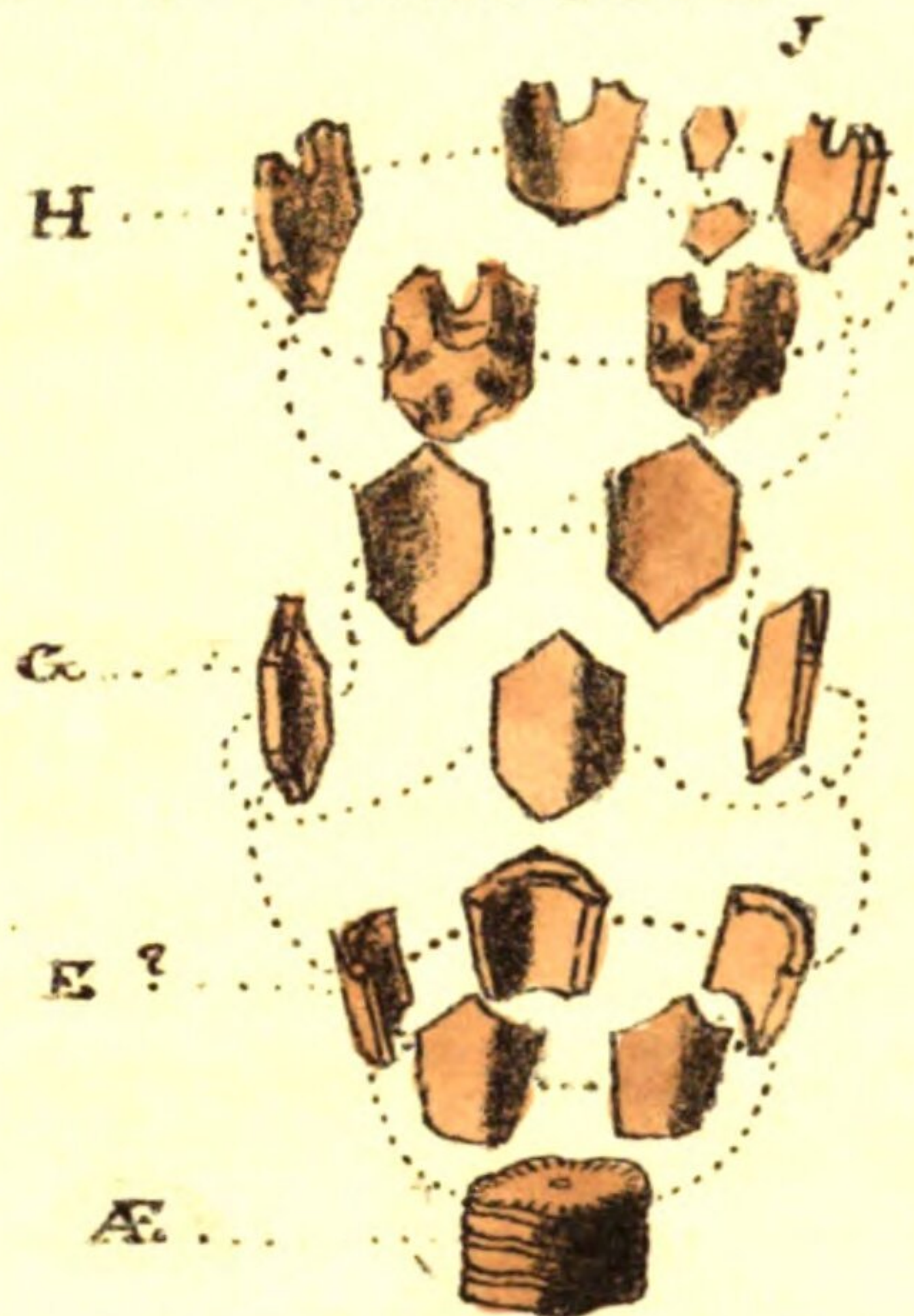
STATE OF NEW YORK

AND

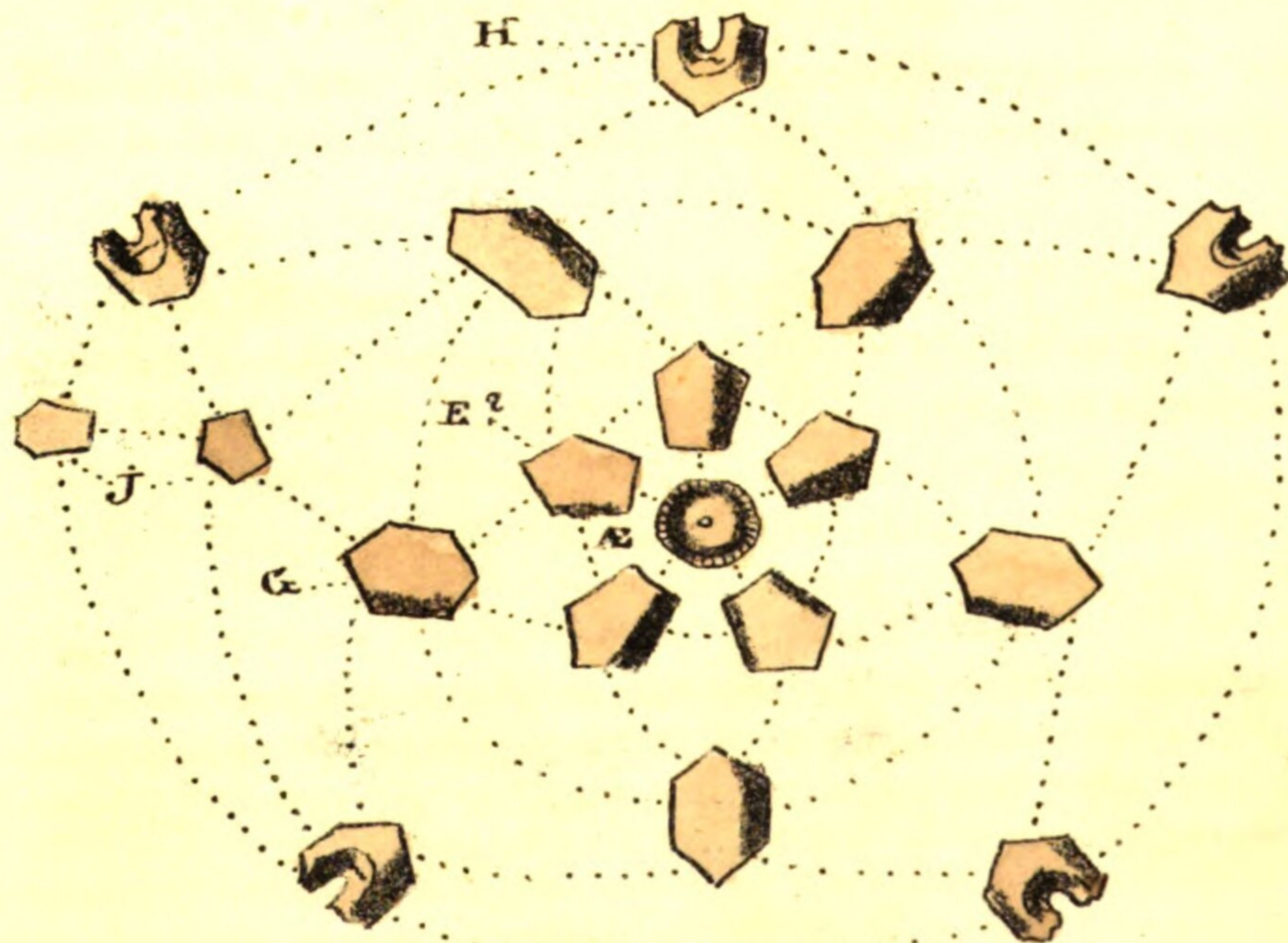
THE

IV. GENUS. POTERIOCRINITES.

1. SP. P. CRASSUS. —



2. SP. P. TENUIS. —



Miller del.

IV. GENUS POTERIOCRINITES.

VASE-LIKE LILY-SHAPED ANIMAL.

Generic Character.

A Crinoidal animal, with a round column composed of numerous thin joints, having in their centre a round alimentary canal, and articulating by surfaces striated in radii. Round auxiliary side arms proceeding at irregular distances from the column. Pelvis * formed of five pentagonal plate-like joints, supporting five hexagonal intercostal plate-like joints, and five plate-like scapulæ, having on one of the intercostals an interscapular plate interposed. An arm proceeding from each of the scapulæ.

Base, probably fascicular, and permanently adhering.

Observation.

The generic name is derived from ΠΟΤΗΡΙΟΝ, a drinking vessel, having been suggested by the resemblance of its figure to that of a common conical wine glass.

This genus, as far as I have been able to ascertain, contains two species only, *P. Crassus*, and *P. Tenuis*; the former, as was observed, serves as a type for the generic character, the latter bears analogy to it in general formation, but from its plates only adhering by sutures, and not showing articulations, renders the transition to the division *INARTICULATA* perfect. No recent individual belonging to this genus has been as yet discovered.

* It is with considerable hesitation that I describe these five plates as belonging to the Pelvis, the analogy of their lower articulating surfaces, seems, perhaps, rather to indicate their belonging to the first costal series. I have never yet had an opportunity of seeing the connection of these plates with the first columnar joint fairly developed, and it seems possible that the true pelvis may be small and almost concealed. This doubt will be done away by the acquisition of more instructive specimens, and my thus stating the case must be considered as resulting from an anxious desire to check errors. It is not unlikely that the real joints forming the pelvis are so much abbreviated as not to be visible externally. Every one acquainted with fossils must be aware how difficult it is to trace always organic details in them correctly, and how many specimens are sometimes necessary to ascertain a single fact.

1. SPECIES. POTERIOCRINITES CRASSUS.

THICK VASE-LIKE LILY-SHAPED ANIMAL.

Specific Character.

A Crinoidal animal, with a column formed of numerous round thin joints, articulating by surfaces striated in radii. The plate-like joints of the pelvis, the intercostæ, and scapulæ, adhering at their upper and lower surfaces by elevated transverse ridge-like processes.

Reference and Synonymes.

G. CUMBERLAND, in Transactions of the Geological Society, Vol. v. p. 90. Pl. 3. fig. 2.

Locality.

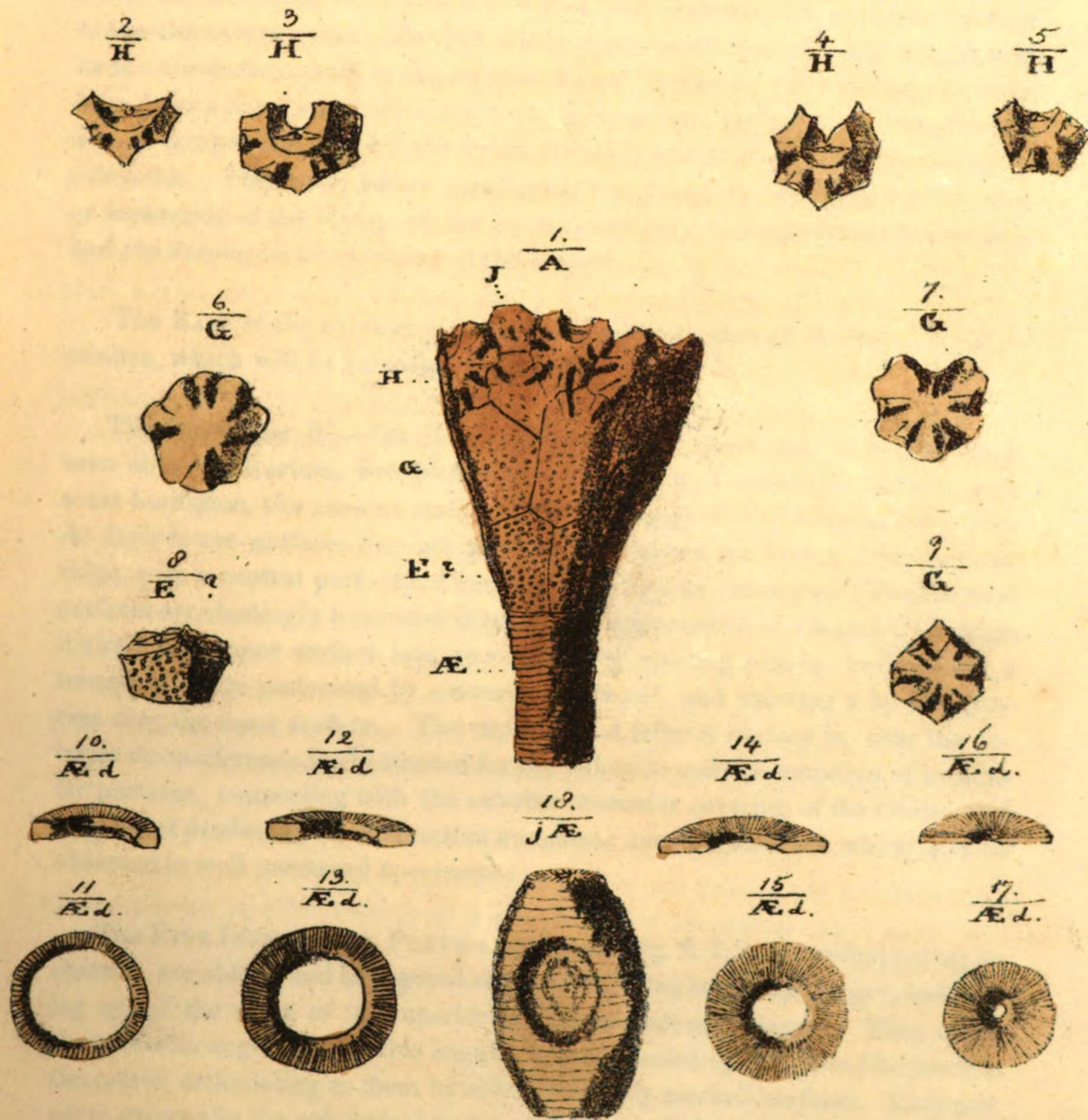
In the Mountain Limestone, in Yorkshire. In Mountain Lime, at Bristol, near the river Avon Bed 1. and 14. of Dr. BRIGHT's Paper in Trans. of Geol. Soc. vol. iv. p. 193. In the Magnesian Beds of the Mountain Limestone, Clevedon Bay, Somersetshire.

The specimen mentioned in Dr. WOODWARD's Catalogue of foreign fossils. (page 19. 8. 1.) as coming from Syria, is of this species. I am indebted to the Rev. A. SEDGEWICK, Woodwardian Professor, Cambridge, for ascertaining this fact, he having kindly furnished me with a drawing made from the original, now in Dr. WOODWARD's Collection, and under his care.

Description.

The COLUMN.—This Crinite, which grows to a large size, is remarkable for its thin, simple, finely radiating columnar joints (fig. 10. to 17.) has a few irregularly placed, long auxiliary side arms, formed of rather thicker and less

POTERIOCRINTES CRASSUS



Miller. del.

POTTERIOCKRINTEN CRASSIS

1840



THE POTTERIOCKRINTEN CRASSIS
IS A COLLECTION OF THE
MOST IMPORTANT
AND INTERESTING
FACTS OF THE
HISTORY OF THE
CITY OF POTTERIOCKRINTEN
FROM THE
EARLIEST
TIMES TO THE
PRESENT
DAY.

finely striated joints; having a contracted circumference of articulation. Its column has sometimes numerous joints (fig. 18.) swelling gradually out, and thus giving it a barrel-shaped appearance, generally pressed in on one of its sides, and becoming there concave, with a central perforation evidently leading to the alimentary canal. This has all the appearance of acicatrized wound, and as the alimentary canal in the column is not increased, the swelling can only arise from a more rapid secretion from these joints, probably to strengthen it, and to compensate thus for the injury probably sustained in one of its auxiliary side arms. The cavity before mentioned, was probably produced by the loss or separation of the stump of the injured auxiliary side arm from the column, and the subsequent cicatrizing of the wound.

The **BASE** of the column is probably similar to that of the genus *Cyathocrinites*, which will be hereafter described.

The **PELVIS** (fig. 8.)—On the superior columnar joint rest, as far as I have been able to ascertain, five plate-like joints, which I consider, though with some hesitation, (for reasons stated in the note, page 67.) as forming the pelvis. At their lower surfaces they are smooth, but have a transverse subtriangular ridge, with a central perforation and a narrow lip-like extension. Their lateral surfaces are slantingly truncated to admit the intervention of a muscle. A ridge divides the upper surface into two angularly slanting planes, having each a transverse ridge perforated by a nourishing vessel, and showing a lip-like process near the inner surface. The superior and inferior surface is, near the exterior circumference finely striated for the adhesion and transmission of muscular portions, connecting with the exterior muscular covering of the crinite, and capable of producing on contraction numerous minute tubercles, which may be observed in well preserved specimens.

The **FIVE INTERCOSTAL PLATE-LIKE JOINTS** (fig. 6. 7. 9. the animal having no costals), are oblong and hexagonal, one of them being somewhat longer, and having one of the sides of its superior surface considerably larger. They insert their inferior angle into the five angular spaces formed by the plate-like joints of the pelvis, articulating to them by nearly similarly marked surfaces. They preserve externally the subconical figure, and thus enlarge the abdominal cavity.

The **SCAPULÆ** (fig. 2. to 5.) are inserted into each of the superior angles of the intercostals. They are thin, plate-like, and subpentagonal, adhering by subtrian-

gular ridges to the intercostals, and by their lateral surfaces to each other. They are obliquely truncated at their superior surfaces, excavated, and have a horse-shoe-like impression, with a subperforated elevated transverse ridge.

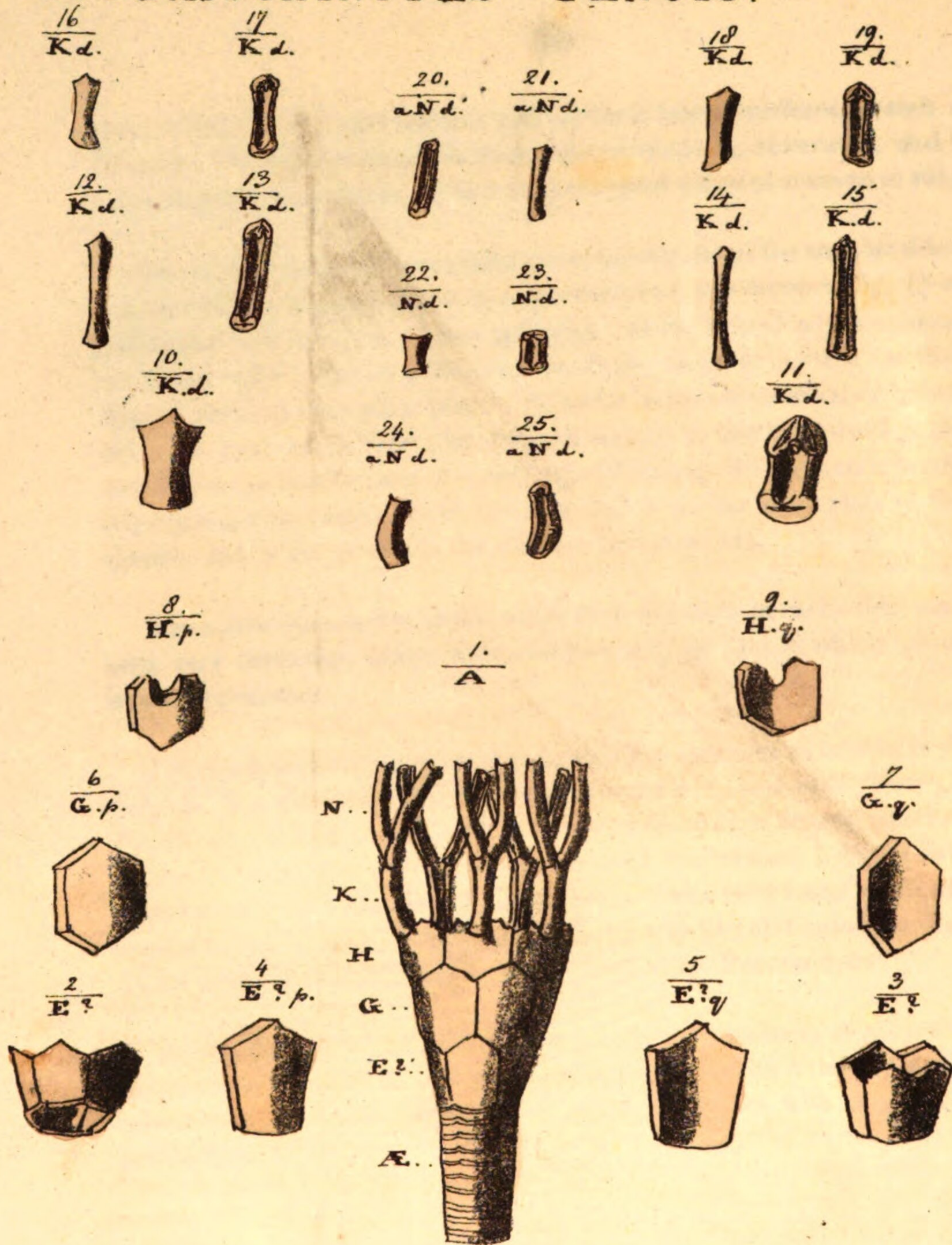
One of the hexagonal intercostal joints having one of the angular sides of its superior surface elongated, has in a specimen in my possession (fig. 1.) a small pentagonal interscapular plate adhering, whose lateral edges connect with the lower edges of the scapulæ, and on whose superior surface another hexagonal interscapular plate rests. To avoid an increased distance between the the arms proceeding from the scapulæ nearest to this interposed plate, they themselves are smaller, and of a contracted form (fig. 5.) I cannot account for this apparent irregularity in *P. Crassus*, but a similar one exists in the next species, and in the genera in the division *INARTICULATA*.

The intercostals and scapulæ where they articulate to each other, must have been very muscular, hence a contraction may be traced which produces a waved appearance.

I have not been fortunate enough to obtain a specimen extending beyond the scapulæ, but from the occurrence on the same slab, (see plate *Poteriocrinites Tenuis*, fig. 10. and 11.) of joints of the arms, hands and fingers, which, in their organic construction, resemble those of the *Pentacrinites*, I do not hesitate to consider these as belonging to this species. I also have found small plates belonging to the integument extending over the cup-like abdominal cavity, and I do not doubt its resemblance to that noticed in the *Pentacrinites*.

In one instance I have observed a proof of the softness or muscularity of the inside of the pelvis, one of its plates having retained the impression of a columnar joint, which, by accident, came in contact with it previous to its petrification.

POTERIOCRINITES TENUIS.



Miller, del.

II. SPECIES POTERIOCRINITES TENUIS.

THIN VASE-LIKE LILY-SHAPED ANIMAL.

Specific Character.

A Crinoidal animal with a column formed of numerous round thin joints, surface of articulation radiatingly striated. The plate-like joints forming the cup-like body, articulating by minute striæ. One arm proceeding from each scapula supporting two fingers.

Locality.

In the Mountain Limestone of the Mendip Hills, and in the Black Rock (the fourteenth bed of Dr. BRIGHT's series; see Geol. Trans. Vol. IV. p. 193.) near the river Avon, Bristol, belonging to the same formation.

Description.

It is a much neater and smaller species than the former.

Its COLUMN (fig. 1.) must have possessed near the summit a considerable degree of muscularity, since the thin joints of this part appear to have yielded to the impression of the lower part of the pelvis joints, and the pressure of the muscle acting on them, so as to assume a slightly-waved marginal outline.

The PELVIS (fig. 2. to 5.) together with the five intercostals (fig. 6. and 7.) and the scapulæ (fig. 8. and 9.) adhere by slightly striated surfaces, and with the intervening pentagonal and hexagonal plates form a small and elegant truncated cup.

The ARMS (fig. 12. to 21.)—From the scapula proceeds immediately the cuneiform joint of the arm, it is very slender and long, yet in general construc-

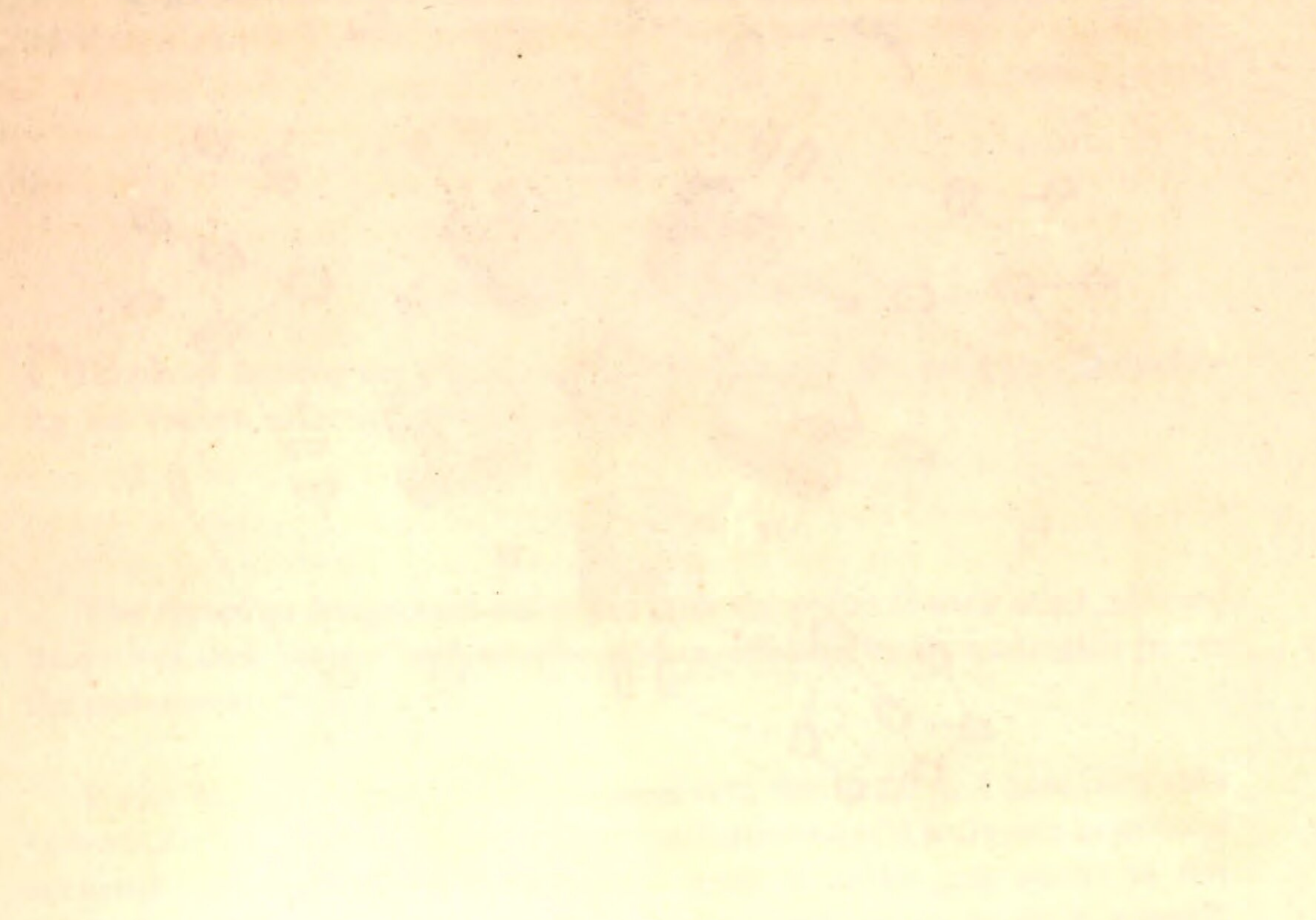
tion and articulation resembles the corresponding joint of the *Pentacrinites*. Its length, not unfrequently, exceeds its thickness six times, whence it bears a distant resemblance to a split os humeri of a very small size.

FINGER JOINT.—From its summit proceed the first joints of two fingers, (fig. 24. and 25.) they are equally slender, adhering near the base laterally to each other. On these the following finger joints (fig. 22. and 23.) are inserted in single series, they are much excavated at the inner surface, and by the alternately inclining angle of their superior surface, indicate that the tentacula came off alternately from the broader portion of every joint. The specimen in my possession does not display the tentacula, nor have I been able to trace their place of insertion on the finger joints, but I apprehend that these being so thin, and not offering a safe point of attachment, a muscular adhesion existed in this species. I have also found minute plates indicating that the cup-like abdominal cavity, and the excavated sulci in the arm and fingers have been protected by a plated integument, similar to that noticed in other *Crinoidea*.

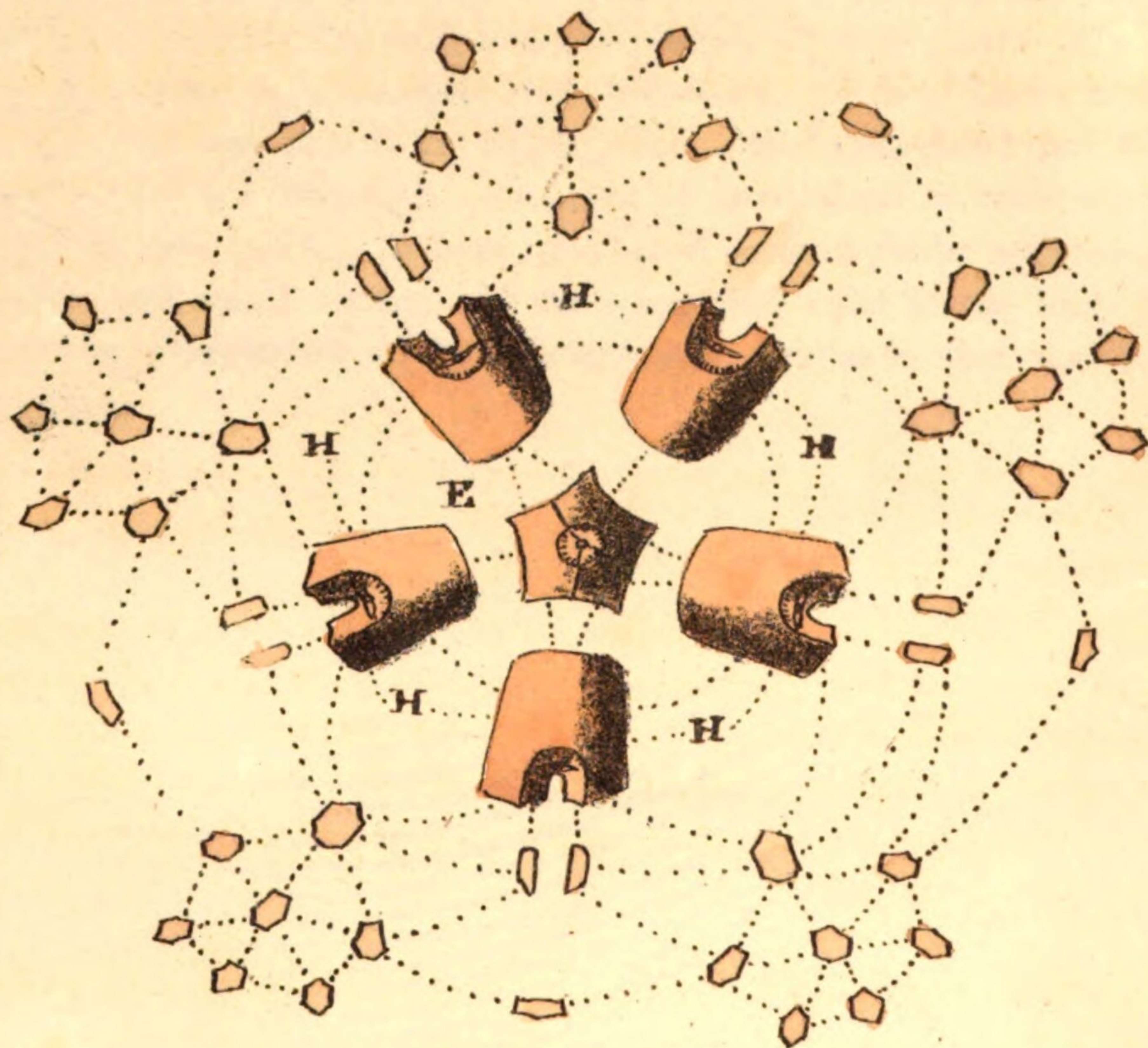
V. GENUS

PLATE 1

CRINOID



V. GENUS
PLATYCRINITES.



Miller. del.

III. Division.

CRINOIDEA INARTICULATA.

Character of the Division.

THE plates forming the superior cup-like portion of the animal, and enclosing the viscera, adhering by muscular sutures.

Observation.

The muscular integument which connects the plates to each other, also extends over their interior and exterior surface, effecting by its contractile power the movements of the arms.

It may be here observed as a geological fact, that as far as I have been able to ascertain, the remains of the animals of the former and of this division have never occurred otherwise than in the inclined strata, from the grau wacke to the new red sandstone; whilst those of the first division belong to the horizontal and more recent beds.

V. GENUS. PLATYCRINITES.

BROAD-PLATED, LILY-SHAPED ANIMAL.

Generic Character.

A Crinoidal animal, with an elliptic or (in one species) pentagonal column, formed of numerous joints, having a few side arms at irregular distances. Pelvis, saucer shaped, formed of three unequal pieces, from which five large plate-like scapulæ proceed.

Base provided with numerous fibres for attachment.

Observation.

The generic name has been derived from *πλαττός*, broad or flat, with reference to the form of the scapulæ.

The want of costæ supplied by the large plate-like scapulæ gives the superior part of these animals a pentagonal appearance, and furnishes so conspicuous a character, that they are readily distinguished from all other genera.

I. SPECIES. PLATYCRINITES LÆVIS.

SMOOTH, BROAD-PLATED, LILY-SHAPED ANIMAL.

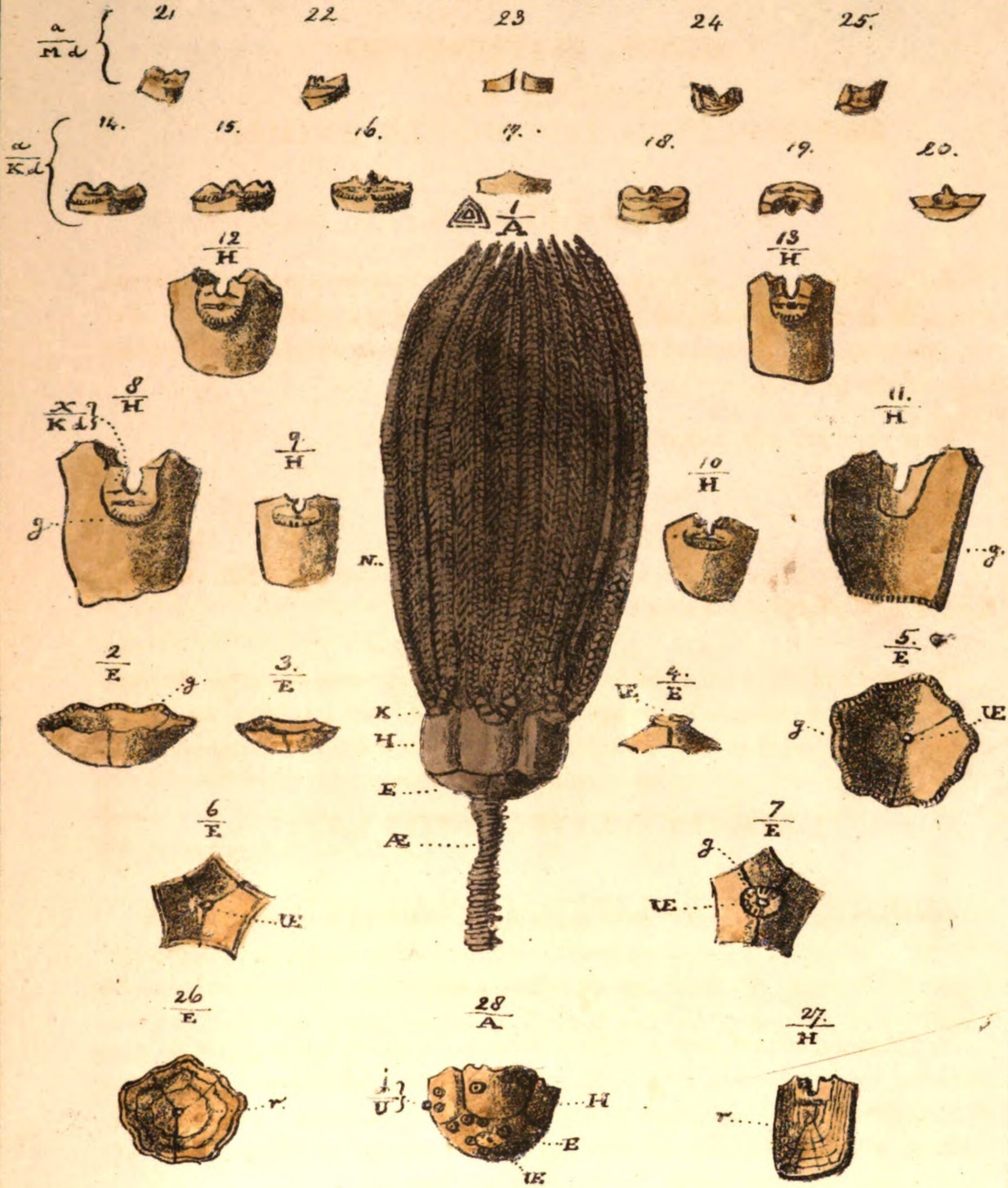
Specific Character.

A Crinoidal animal, with a column formed of very muscular elliptical joints adhering by a transverse ridge. Round side arms, occasionally proceeding from the column, whose joints adhere by radiated surfaces. Pelvis, saucer-shaped, with the five scapulæ adhering to it, from each of which an arm proceeds supporting two hands, having each two fingers.

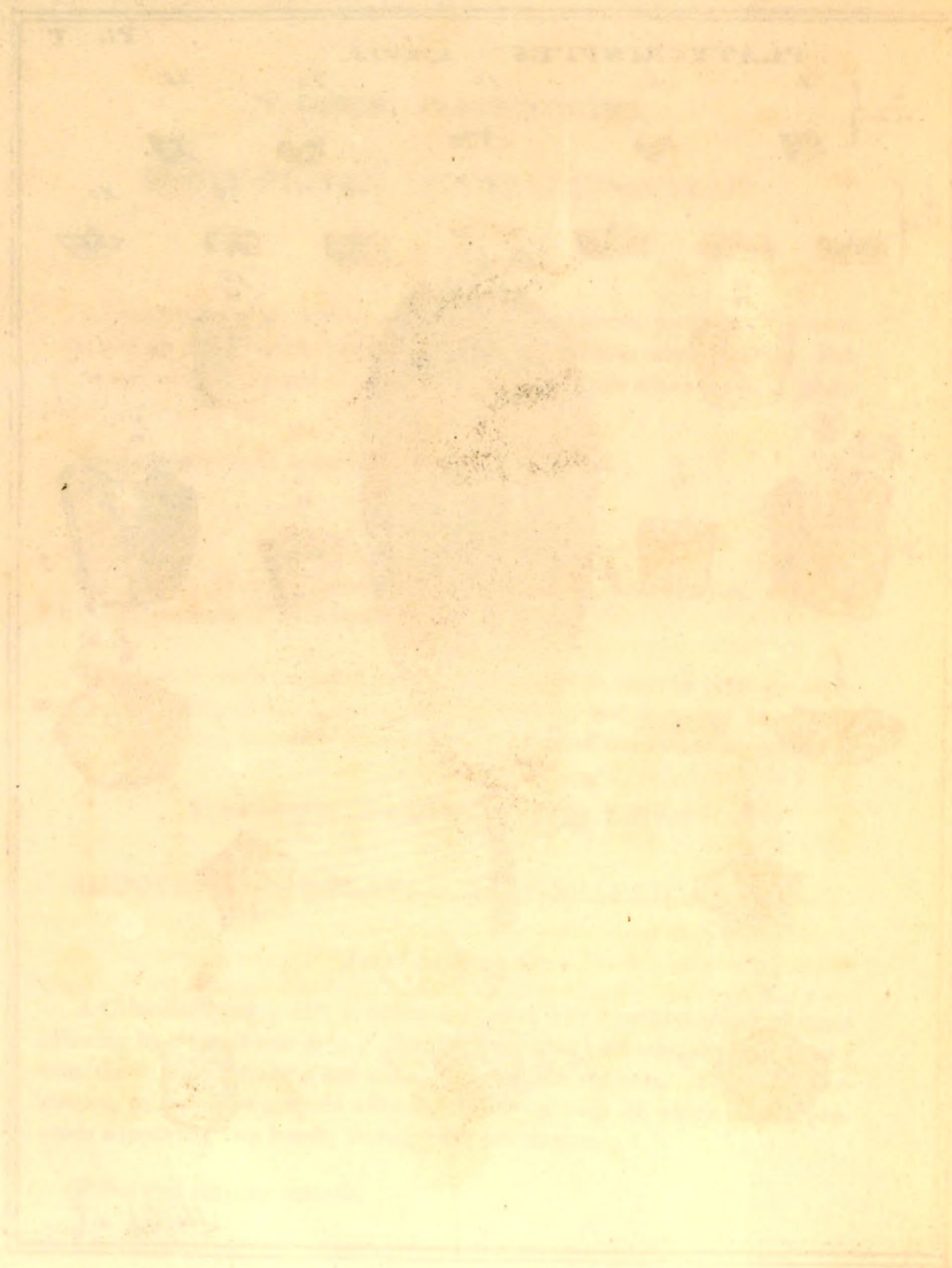
Pelvis and scapulæ smooth.

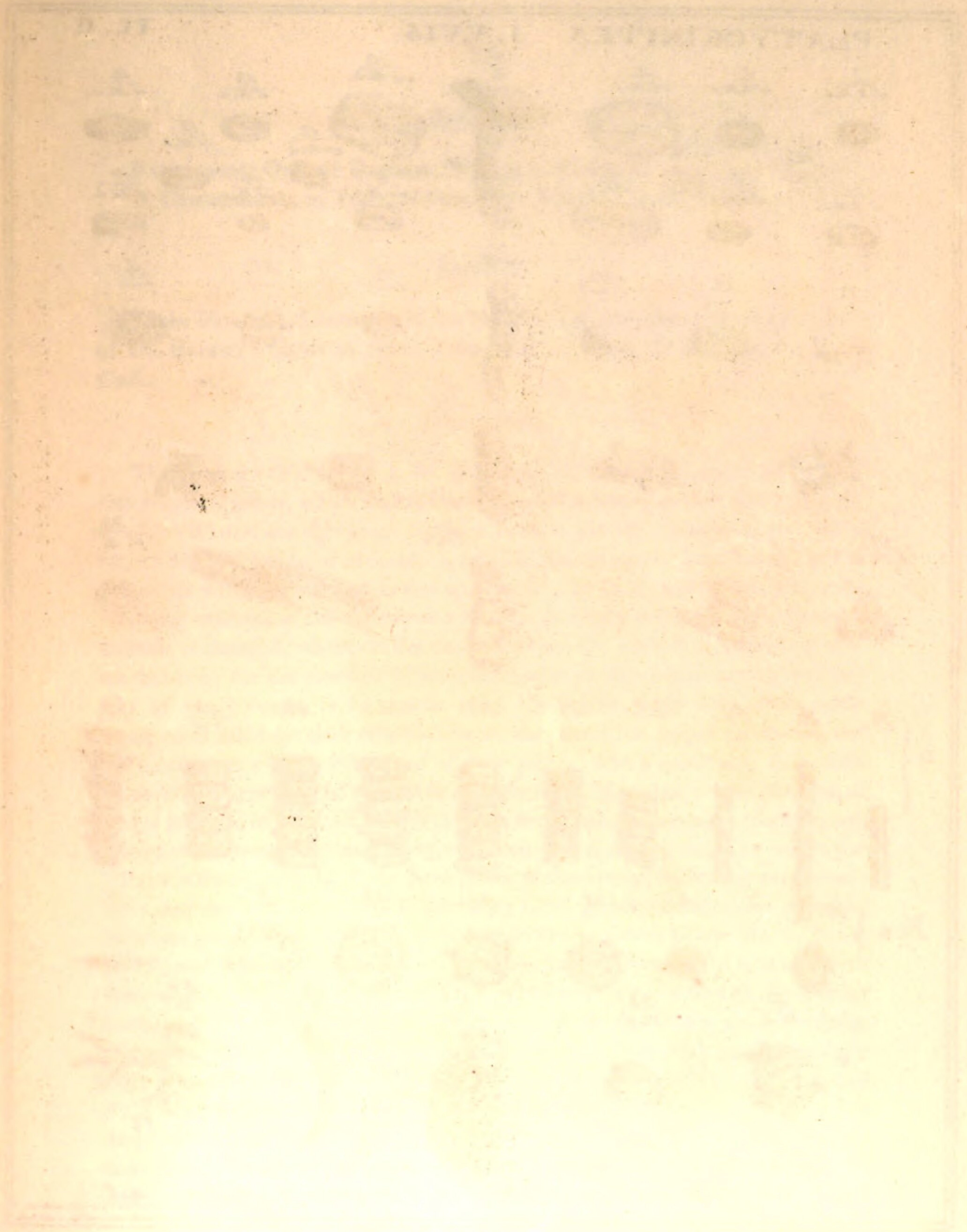
PLATYCRINITES LÆVIS.

PL. 1



Miller del.

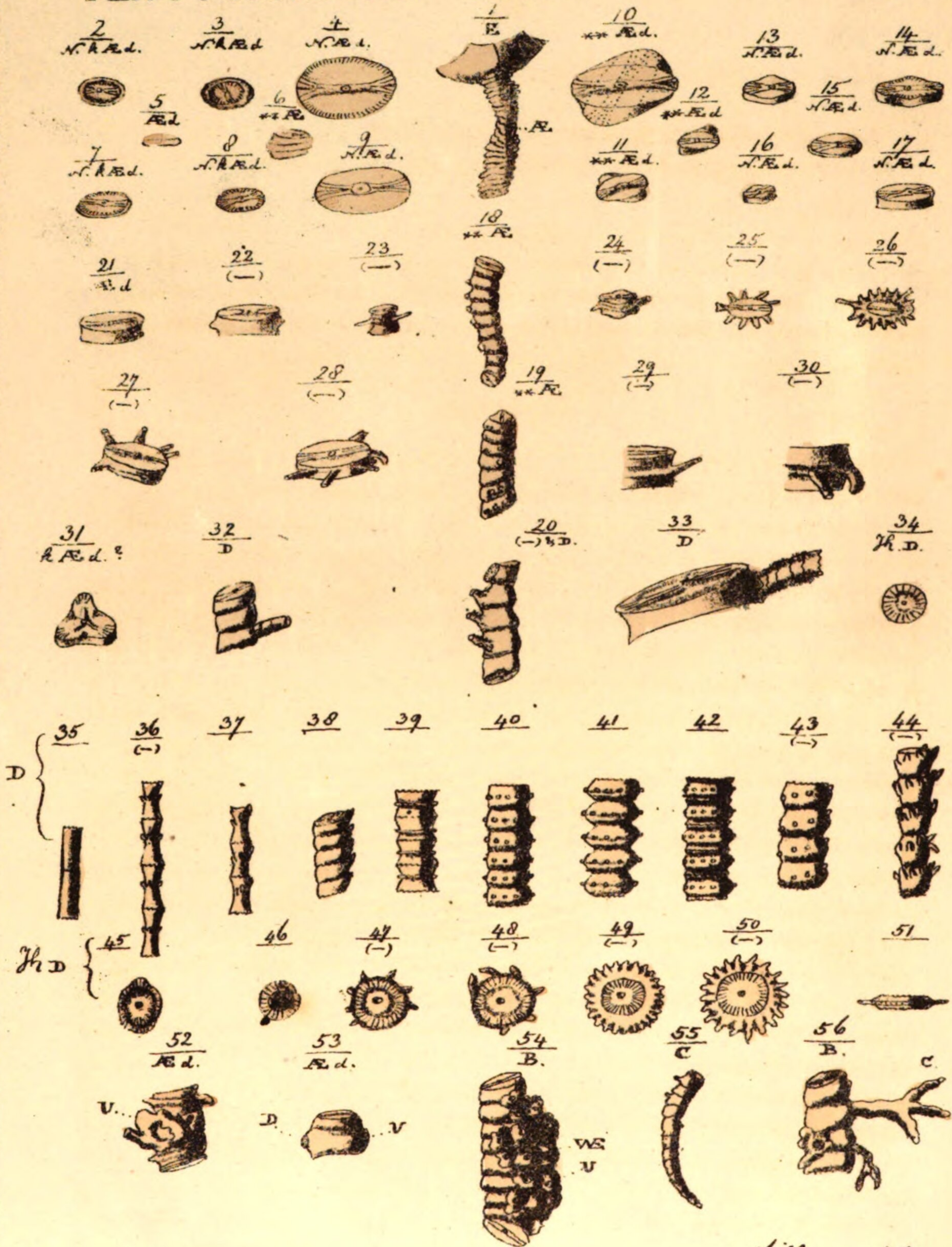




PLATYCRINITES

LÆVIS

PL. II



Miller del.

Reference.

PARKINSON'S Organic Remains, VOL. II. t. 17. fig. 12.

G. CUMBERLAND, in Trans. of Geol. Soc. VOL. v. t. 5. fig. 8.

Locality.

In the Mountain Limestone of the Mendip Hills, the Black Rock (14th bed of Dr. BRIGHT'S Series in Geol. Trans. Vol. IV.) near Bristol, Dublin, and Cork.

Description.

The COLUMN (PL. II. fig. 1. 18. to 20.) of this animal is formed of numerous elliptical joints, which near the pelvis are of an almost round figure (PL. II. fig. 1. to 3.) and are for some distance from it placed alternately, so that a larger and thicker joint succeeds a smaller and thinner. The articulation of the pelvis with the column in this species (PL. II. fig. 1. and 2.) affords an interesting example of the manner in which the ordinary structure of the parts of animals is changed, whenever the circumstances are such as to require a new mechanism; for the mode of articulation between the joints throughout the rest of the column, is by means of a transverse ridge only, that mode being most fitted for their elliptical form; but since the upper columnar joint has to support a pelvis composed of three pieces, which could not, from their mode of construction, be affixed to a single ridge, this plan is here abandoned and a new one introduced, which consists in the joint assuming a round figure, having at its upper surface a margin marked with radiating striæ, on which the inferior striated surfaces of the three pelvis plates are applied in the usual manner; and the transverse ridge is here very faintly exhibited. Similar marginal radii are seen, but more and more faintly, in several joints below (PL. II. fig. 3. to 15.) and soon totally disappear, when the joints become of a true elliptical form and thicker. The transverse ridge on the superior and that on the inferior surface of the joint have (even when these are not thicker than a piece of writing paper) a decided tendency to assume a direction oblique with respect to each other, which is still more conspicuous when the joint is larger (PL. II. fig. 10. and 11.) This appearance has led me to suppose, that in a living state the inferior and superior surfaces of each joint with their articulating ridge, were alone truly calcareous, having a yielding muscular or cartilaginous substance interposed between them. In consequence of the adhesion of the superior surface of each

joint to the inferior of that contiguous to it, and their firm articulation by means of the transverse ridge, the animal was capable of producing through its muscular integument, a kind of twisting, vermicular spiral motion (PL. II. fig. 1. 18. to 20.) shortening the column by compressing the muscle between the two calcareous plates of each joint, and elevating it by untwisting and restoring it to its former elasticity. It is evident that this motion would, in many ways, render the lateral motion of the superior part of the animal on its column less necessary; and since the attachment of the pelvis to the column appears to have been slight, and might have been endangered by such a motion, this may have been the object of the contrivance. When the two hard elliptical surfaces, with their elevated ridges are placed obliquely to each other, the joint evidently appears to be considerably compressed, and has a slight four-cornered appearance, having the angles rounded; while along the middle of the exterior circumference the intermediate muscle is pressed out (PL. II. fig. 21. to 30.) it forms a smooth rim, which is sometimes studded at intervals with tubercles occasionally elongated into a kind of pointed feelers, giving the joint some resemblance to the rowel of a spur. (PL. II. fig. 25. to 26.) In general the protruding feelers are longer near the ends of the greater diameter of the elliptical joint, sometimes assuming an inclining direction (PL. II. fig. 28. and 30.) and having an indented summit. The alimentary canal of the column is small, probably because the muscular integument was more vascular.

The BASE. (PL. II. fig. 52. to 56.) The columnar joints are sometimes rendered unshapely by exuded calcareous matter (PL. II. fig. 52. and 53.) which, near the base, appears to have partially surrounded those numerous muscular fibres which served the animal as organs of attachment. (PL. II. fig. 55. and 56.) In specimens where these fibres are decayed and lost, many cavities are left behind in the indurated matter, demonstrating their points of insertion. (PL. II. fig. 54.)

The AUXILIARY SIDE ARMS. From the ends of the greater diameter of the elliptical columnar joints proceed the auxiliary side arms (PL. II. fig. 32. and 33.) formed of numerous round joints, perforated in the centre, and adhering by surfaces striated in radii. I have specimens in my collection (PL. II. fig. 39. to 44. fig. 47. to 51.) which from their analogy to some side arms still attached to the column, I consider as continuations of the same. They are remarkably neat, round, and prove their former muscularity by the contraction

of their exterior integument. Thus the smooth round joint of the side arm shows at its external circumference an elevated rim (PL. II. fig. 39.) the first vestige of contraction, which may be traced through a series of specimens, to swell and increase more and more on one side, gradually becoming tubercular, (PL. II. fig. 40. to 42.) and sending off from about six to eight spine-like muscular elongations (PL. II. fig. 43. and 44.) not unfrequently proving their former muscular state by a curved inclination downwards. The more the muscle is thus protruded, the closer it approaches to the superior surface of the joint; the line of tubercles assuming a somewhat spiral turn, whereby the joint receives a truncated conical figure, its superior surface forming the base of the cone. In young undeveloped specimens the tubercles form a still greater spiral curve. On the surface of the same mass of partially decomposed limestone, I have met with very thin joints resembling those just described, only being very small and much longer, which I apprehend belong to this species. (PL. II. fig. 35. to 37.) Another portion of side arms has also occurred (PL. II. fig. 38. and 45.) where the joints are elliptically compressed, articulating by finely striated surfaces, and having a sort of serrated projection near the upper margin of the joint at the exterior circumference, within the line of curvature when the arm is bent.

The PELVIS (PL. I. fig. 2. to 7.) is saucer-shaped, composed of three plates, forming at their superior edge five concave spaces, which are generally finely striated to give a firmer adhesion to the scapulæ.

The SCAPULÆ (fig. 8. to 13.) are five, tile-shaped, thin plates, adhering by their lateral edges to each other, truncated above, and angularly bevelled to these lateral edges. In the centre, at the superior edge, they are excavated, having a somewhat reniform or horse-shoe shaped impression on the exterior, which presents a ridge of articulation with a central perforation for the reception of the arms.

The ARMS (PL. I. fig. 1. and 14. to 20.) are formed, each by a single cuneiform joint which adheres to the scapulæ.

The HANDS. (PL. I. fig. 21. to 25.) Two hands proceed from the cuneiform joints of the arm, each is formed by a horse-shoe shaped joint, and a cuneiform one.

TWO FINGERS (PL. I. fig. 1.) set off from the cuneiform joint of each hand. They are composed of two series of joints adhering at one of their lateral surfaces to each other by bevelled edges, in a manner similar to those of *Encrinites moniliformis*.

The TENTACULA.—From the joints of the hand and fingers the tentacula proceed, which resemble those of other crinoidea.

An INTEGUMENT protected by numerous (sometimes very regularly formed) plates, extends as usual over the abdominal cavity and the sulcus on the arms, hands, fingers, and tentacula.

That the plates increased in size by laminar secretions formed externally as in *Apiocrinites rotundus*, I have been able to ascertain from a decomposed specimen. (PL. I. fig. 26. and 27.)

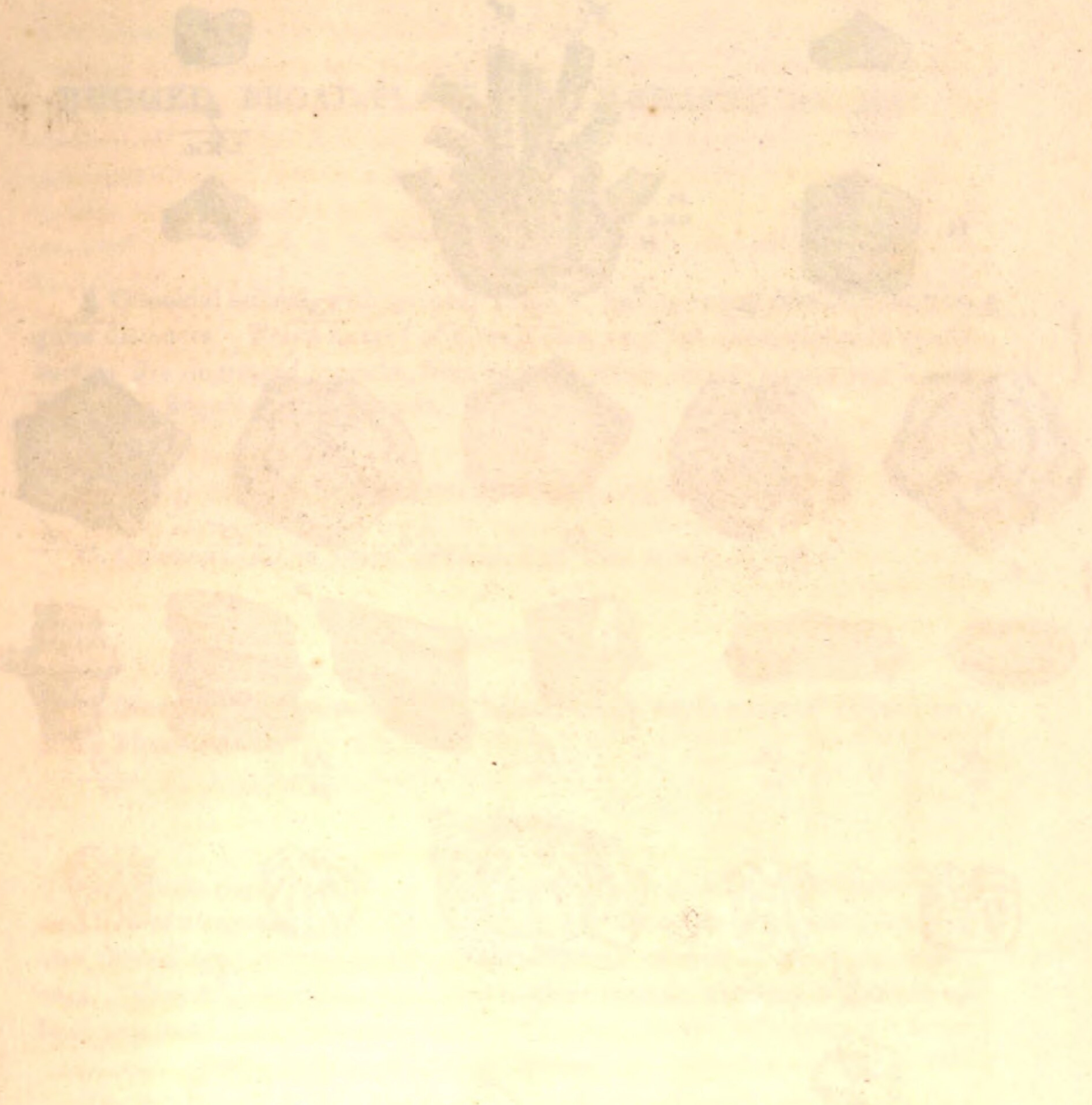
I have a joint (PL. II. fig. 31.) of a subtriangular circumference in my collection, which I apprehend may have been an unusual and monstrous form of the superior columnar joints of this species. The central ridge of articulation noticed in the joints described is here divided into three radii, each subdividing where they approach the exterior circumference, into several fine ridges, and thus rendering the margin crenulated.

In one instance (PL. I. fig. 28.) the pelvis and scapulæ are covered with tubercles indented at their centre, in my opinion the effects of disease.

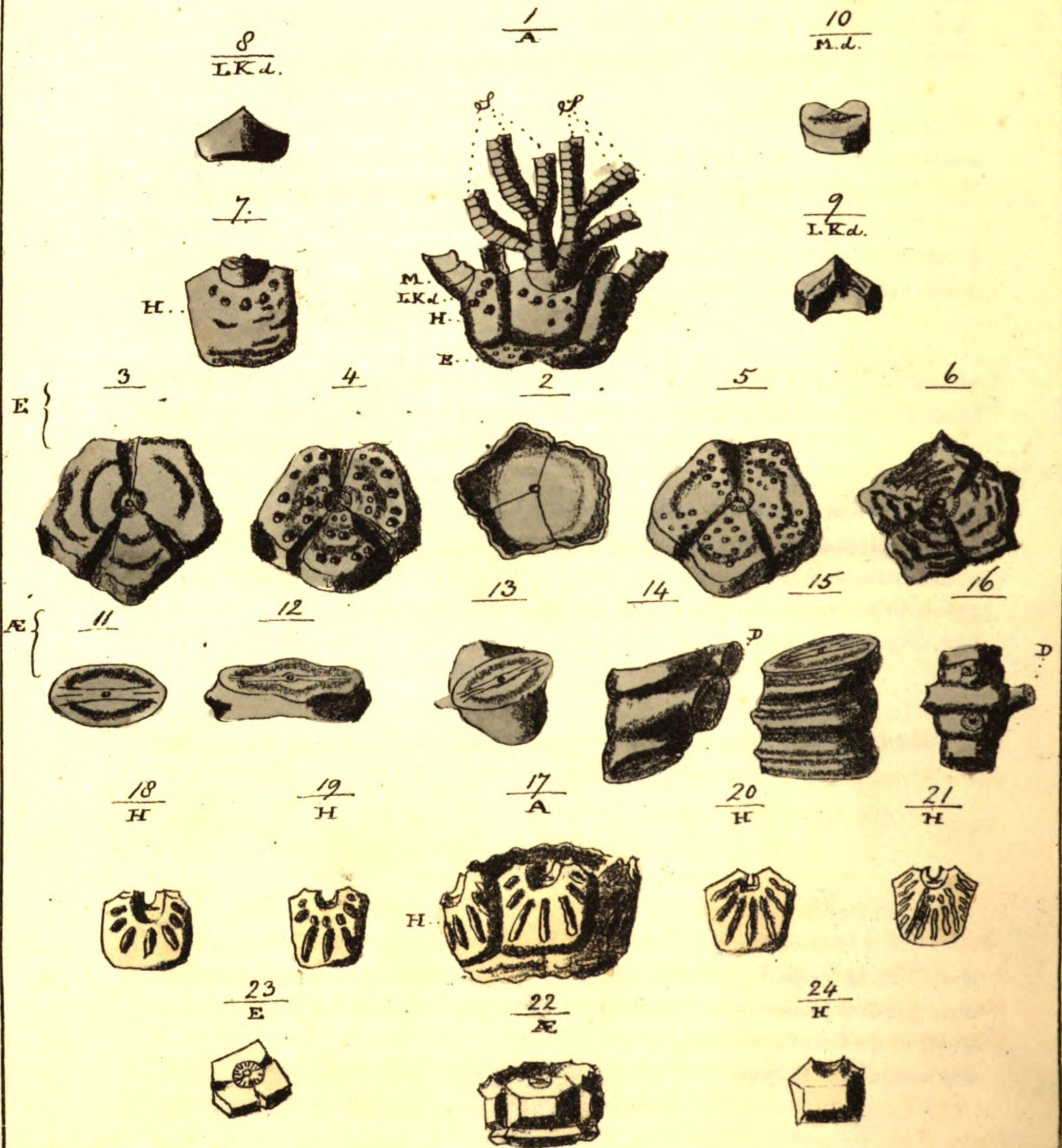
I have noticed in the collection of **RICHARD BRIGHT, Esq.** of Ham Green, near Bristol, numerous joints, probably appertaining to an animal forming a variety of the former, or a distinct species. They came from Muir-kirk in Dumfriesshire. The scapulæ are shorter in proportion than those of the former species, and the columnar joints are finely tuberculated.

PLATYCHINITES RUGOSUS

PLATYCHINITES RUGOSUS



PLATYCRINITES RUGOSUS



Miller. del.

II. SPECIES. PLATYCRINITES RUGOSUS.

RUGGED, BROAD-PLATED, LILY-SHAPED ANIMAL.

Specific Character.

A Crinoidal animal, with an oval column, having round side arms at irregular distances. Pelvis formed of three pieces, very flat, admitting at its upper surface five depressed scapulæ, from each of which an arm having two hands with three fingers each, proceeds.

Synonymes and Reference.

G. CUMBERLAND, in Trans. of Geol. Soc. Vol. v. t. 5. fig. 10.

Locality.

In Mountain Limestone at Caldy Island, on the south coast of Wales; and at the Mendip Hills.

Description.

Its column (fig. 11. to 16.) is of a similar figure to that of the former species, but of a superior size. The exterior tubercles on the columnar joints are also placed near one end of the greatest diameter of their elliptical circumference. They are sometimes depressed at their summit, showing a tendency to form new auxiliary side arms.

The PELVIS (fig. 2. to 6.) is flat, considerably extending beyond the diameter of the column, having at its lower surface the impression for the purpose of articulation comparatively small.

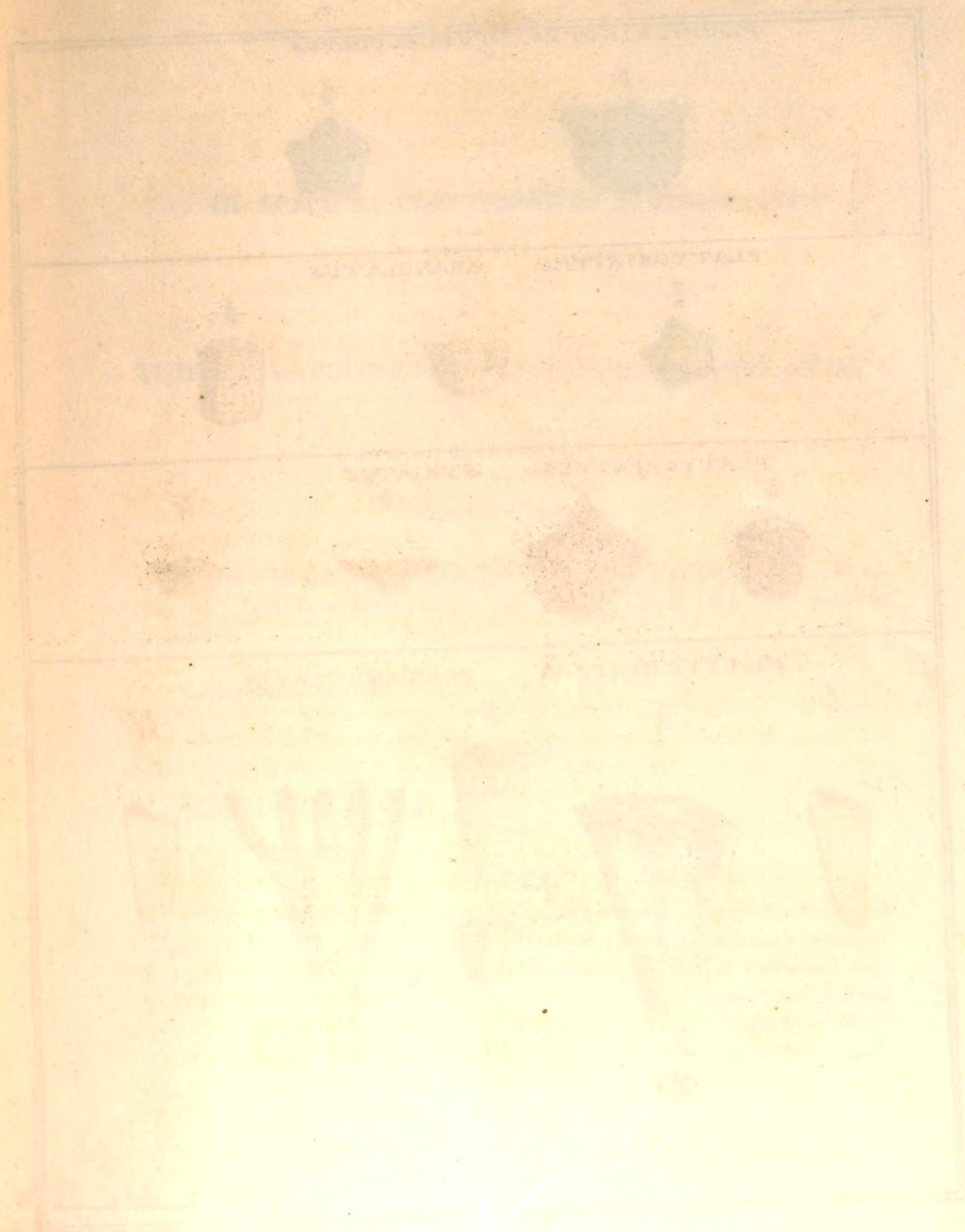
The **FIVE SCAPULÆ** (fig. 7.) adhere to the upper edge of the pelvis, are thick, short, bevelled at the summit, with an excavation, and a horse-shoe shaped impression for the insertion of the arms.

The pelvis and scapulæ (fig. 1. to 7.) are thicker near the centre than at their margin of adhesion, and display their muscularity in a conspicuous manner. Previous to the exertion of the contracting muscular power of the animal they are nearly smooth, sloping towards the sutures (fig. 1. 22. to 24.) On contraction, the bevelled edges become rounded, and the smooth surface undulating and corrugated. (fig. 3. and 6.) On still further contraction, the various branches of the muscles become visible, and the pelvis shows two or three series of tubercles (fig. 1. 4. and 7.) viz. four, three, and two, in the smaller plate of the pelvis, and six, four, and two, on each of the two larger. In this case five or six tubercles are arranged in a crescent on the scapulæ, below the horse-shoe-like depression, having sometimes another similar series under them. In other specimens I have observed each tubercle in this second or lower series, assuming an oblong figure, (fig. 18. and 19.) and traced it until it connected with the tubercle above it, and forming, together with it, a single ridge, (fig. 17. 20. and 21.) thus displaying on each of the scapulæ several radiated ridges. In a specimen in my possession (fig. 5.) a still greater number of tubercles are visible, which are irregularly arranged.

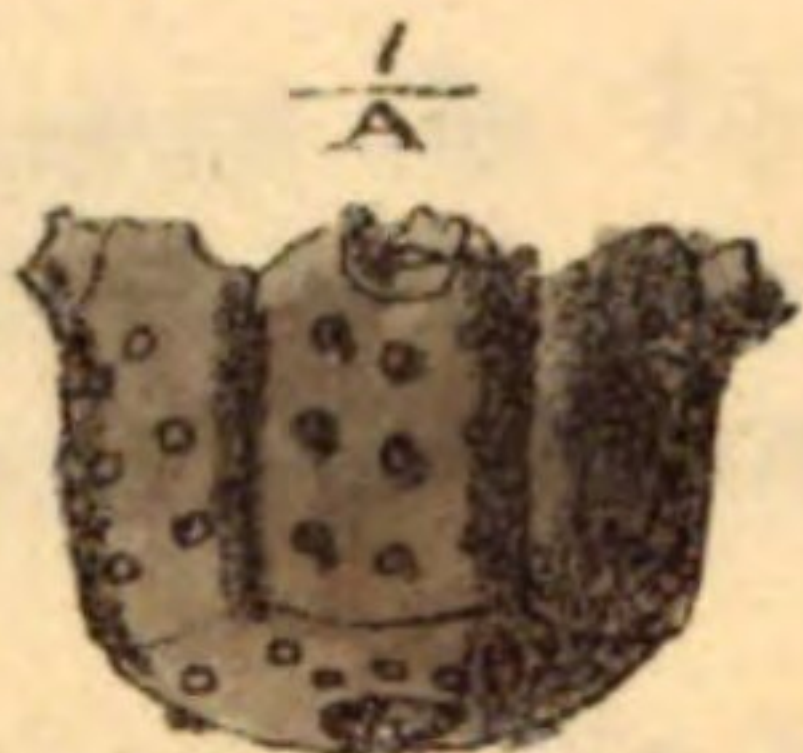
ARMS AND HANDS.—On each of the scapulæ is inserted a cuneiform joint, forming the arm (fig. 8. and 9.) on which the two joints of the first series of the hand affix (fig. 10.) having each at their summit a cuneiform joint, sending off on the one side a finger, and on the other the second series of the hand, surmounted by another cuneiform joint supporting two fingers.

The **FINGERS** (fig. 1.) are formed each of two series of joints resembling those of *Encrinetes moniliformis*, and sending off like them series of tentacula.

The **INTEGUMENT** over the abdominal cavity is protected by large and thick angular plates, and is capable of elongating itself in the centre into a proboscis, analogous to that in *Actinocrinites*, which will be hereafter described.

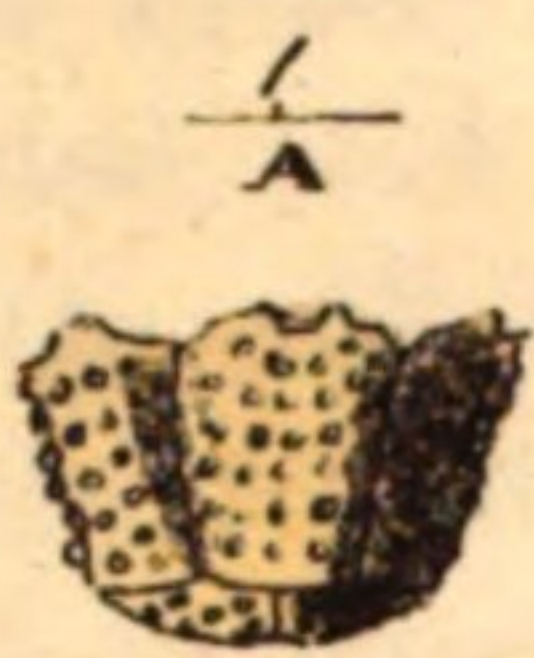
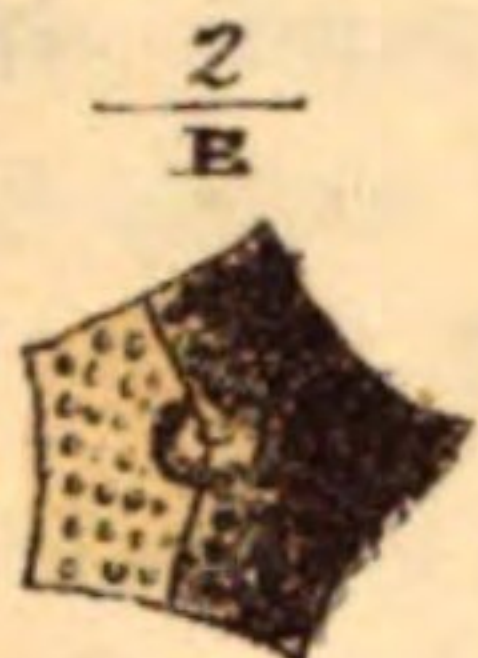


PLATYCRINITES TUBERCULATUS.



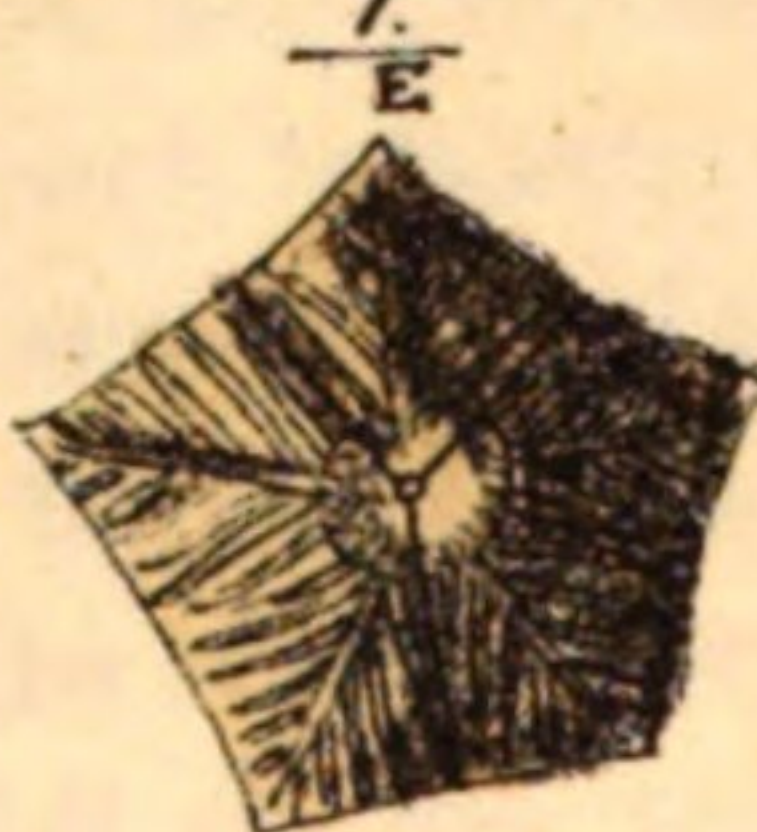
PLATYCRINITES

GRANULATUS



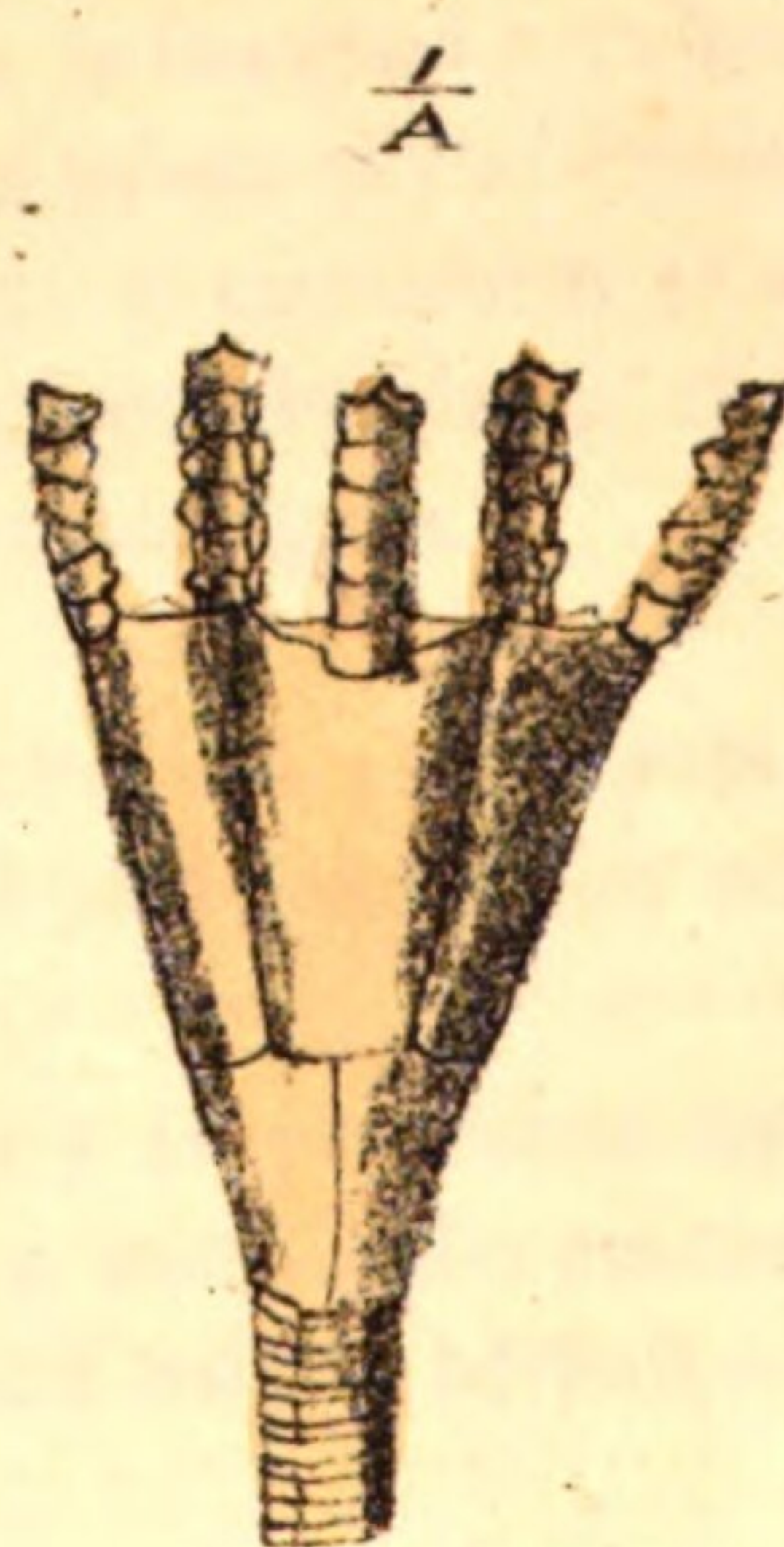
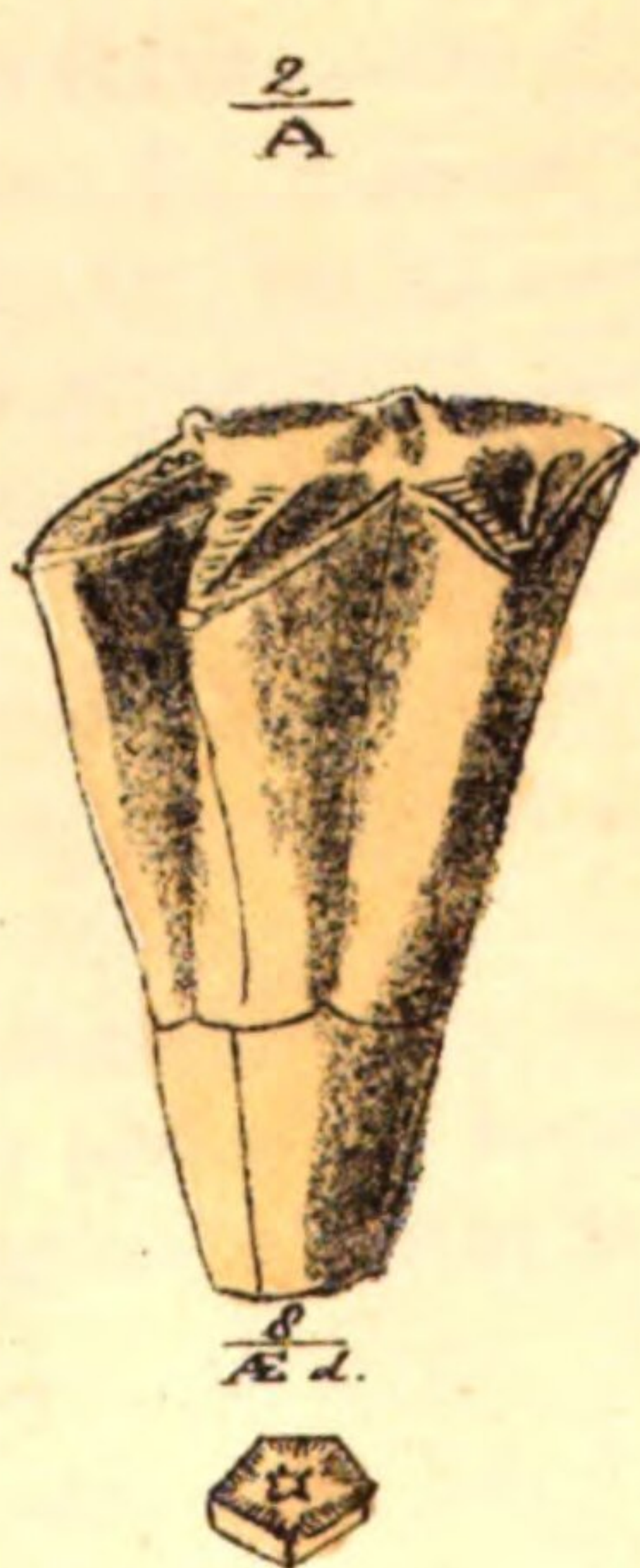
PLATYCRINITES

STRIATUS



PLATYCRINITES

PENTANGULARIS



Miller. del.

III. SPECIES. PLATYCRINITES TUBERCULATUS.

Description.

TUBERCULATED, BROAD-PLATED, LILY-SHAPED ANIMAL.

Specific Character.

A Crinoidal animal, having its pelvis marked with saucer-shaped, five tubercles. Scapulæ of greater length than breadth, having each three series of tubercles.

Column unascertained.

Locality.

The Mountain Lime strata.

Description.

The Rev. Professor BUCKLAND kindly allowed me to examine the Crinoidal remains in the Ashmolean collection at Oxford, many of which once belonged to Lluïd. Among these I discovered the superior portion of this animal (fig. 1. and 2.) which I consider entitled to specific distinction; and although I am well aware that the characters as above given, are scarcely sufficient to establish this claim, yet I cannot doubt but that future researches will prove the correctness of this suggestion.

IV. SPECIES. PLATYCRINITES GRANULATUS.

GRANULATED, BROAD-PLATED, LILY-SHAPED ANIMAL.

Specific Character.

A Crinoidal animal, with a saucer-shaped pelvis. Scapulæ nearly square, with a very small impression for the adhesion of the arms. External surface granulated. Column unascertained.

Locality.

In the Mountain Limestone of the Mendip Hills.

Description.

It is a small, slender, thin and neat species (fig. 1. to 3.) The granulæ (fig. 3.) on the scapulæ are sometimes regularly arranged in series forming radii extending from the horse-shoe-like impression into which the arm was inserted. From the smallness of the horse-shoe-like impression I conceive that the arms were formed of several joints.

V. SPECIES. PLATYCRINITES STRIATUS.

STRIATED, BROAD-PLATED, LILY-SHAPED ANIMAL.

Specific Character.

A Crinoidal animal, with a pelvis formed of three pieces, drawn in near the base, so as to form a projecting rim, by which it acquires a greater surface of adhesion to the column. The five scapulæ have only a small horse-shoe-like impression at their upper edge. Pelvis and scapulæ externally striated. Column unascertained.

Locality.

Black Rock (14th bed of Dr. BRIGHT's series in Geol. Trans. Vol. IV. p. 193.) near the river Avon, Bristol, belonging to the Mountain Lime formation.

Description.

The saucer-shaped pelvis (fig. 1. and 2.) is externally marked by an elevated ridge going to each of its five points, from which other ridges radiate to the concave spaces between them. The ridges on the scapulæ (fig. 3. and 4.) radiate from the horse-shoe-shaped impression at their summit, to the pelvis and their lateral edges. From the neck-like contraction of the pelvis, near its point of adhesion to the column, and its thinness, I suspect that it was covered by a thick gelatinous epidermis, extending itself over the radiated surface to the arm joints.

VI. SPECIES. PLATYCRINITES PENTANGULARIS.

FIVE-ANGLED, BROAD-PLATED, LILY-SHAPED ANIMAL.

Specific Character.

A Crinoidal animal, with a pentagonal column formed of joints alternately thicker and thinner, articulating by a striated rim. At the summit of the column, a cup-shaped pelvis supporting five scapulæ, from which five arms, formed each of five joints and a cuneiform joint, proceed.

Locality.

In the Mountain Limestone of the Mendip Hills, at Weston-super-mare, Black Rock near Bristol, and at Mitchel Dean; also occasionally in transition Limestone of Dinevawr Park, and Dudley.

Description.

The pentagonal column of this Crinite and Cyathocrinites quinquangularis, have led superficial observers to consider it as belonging to the genus Pentacri-

nites, and hence the assertion that, species of that genus occur in mountain and transition lime-stone. But the absence of the pentapetalous semistriated articulation of the columnar joints, and the different formation of the pelvis and plates resting on it, must remove them at once from this class, and place them in their respective genera.

The COLUMNAR JOINTS (fig. 8). are alternately thicker and thinner, but differ very little in their width from each other; they are externally smooth, flat, and acutely angular. At the articulating surface they are surrounded by a striated margin slightly arched, inwardly enclosing a smooth area perforated in the centre by a pentagonal canal, whose points extend to the intervening spaces between the angles of the circumference. In some of these joints the sphincterlike contraction of the muscle near the alimentary canal, its adhesion to the points of the pentagon, and its connection with the joints next below it by longitudinal fibres, has produced a five-fold depression.

The PELVIS (fig. 3.) formed of three plates is cup-shaped, sustaining five long scapulæ (fig. 5.) each having a small horse-shoe-shaped depression at its summit for the insertion of the arms. In one of my specimens (fig. 2. 6. and 7.) the lateral sides of the scapulæ bend in considerably, thereby producing an angular indentation, and giving the summit a stelliform figure. In this specimen may be traced the plates belonging to the integument that covers the abdominal cavity.

An ARM (fig. 1.) proceeds from each of the scapulæ, formed of four horse-shoe-shaped, and one cuneiform joint.

Locality

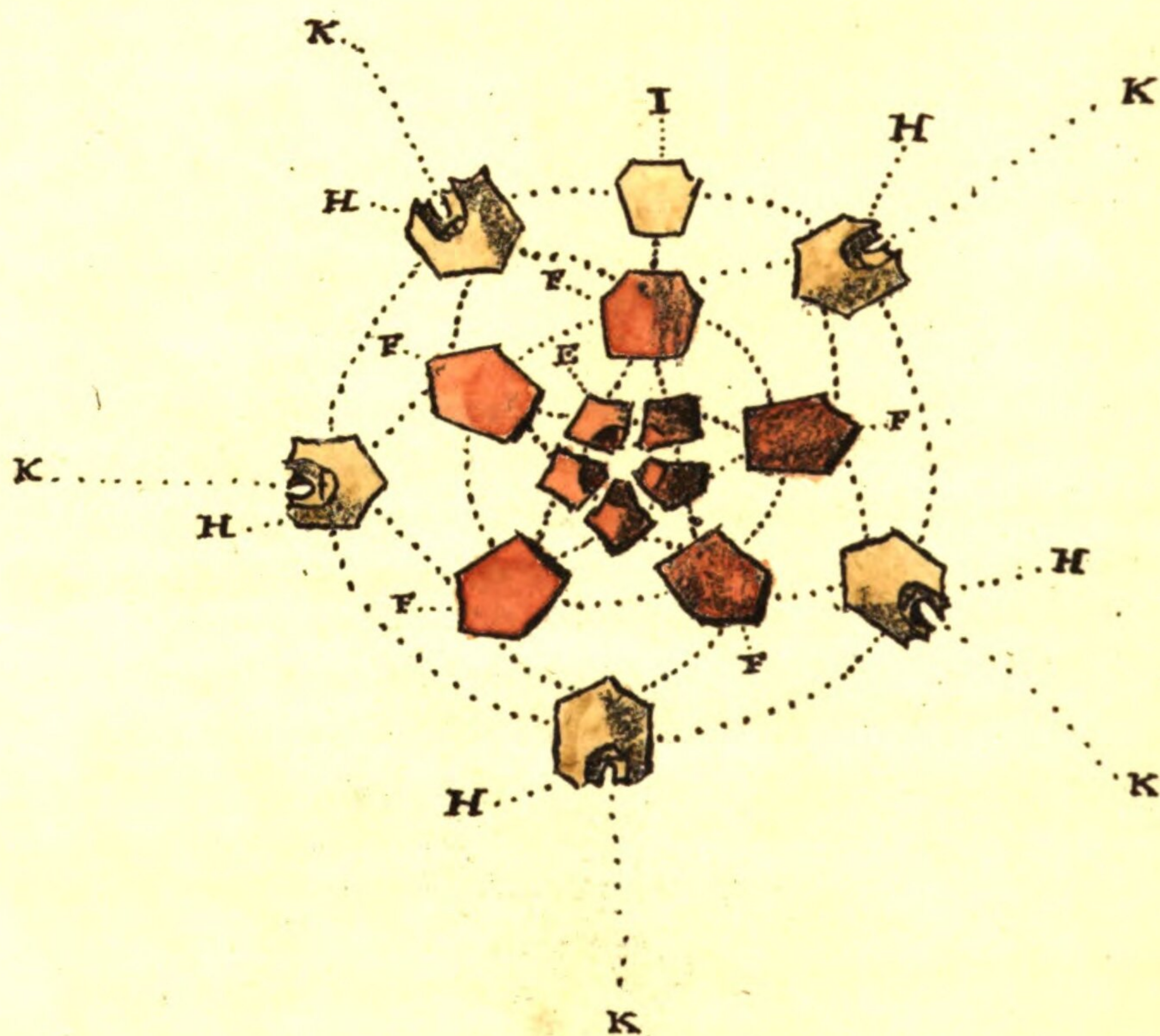
IN GENUS
CYATHOCHLOA

AND ITS
ALLIED FORMS

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WASHINGTON, D. C.

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VI. GENUS
CYATHOCRINITES.



Miller del.

VI. GENUS. CYATHOCRINITES.

CUP-LIKE, LILY-SHAPED ANIMAL.

Generic Character.

A Crinoidal animal, with a round or pentagonal column formed of numerous joints, having side arms proceeding irregularly from it. On the summit adheres a saucer-shaped pelvis of five pieces, on which are placed in successive series, five costal plates, five scapulæ, and an intervening plate. From each scapula proceeds one arm having two hands.

Observation.

The name of this genus is derived from $\kappa\upsilon\alpha\theta\omicron\varsigma$, a cup. None of its species have as yet been discovered in a living state, and all of them are consigned to the transition and Mountain Limestone strata.

1. SPECIES. CYATHOCRINITES PLANUS.

SMOOTH, CUP-LIKE, LILY-SHAPED ANIMAL.

Generic Character.

A Crinoidal animal, with a round column formed of numerous depressed joints, articulating by radiating surfaces, and perforated by an alimentary canal, pentagonal near the pelvis, which becomes round further from it. From each of the scapulæ, which rest on the summit of the cup formed by the pelvis and costæ, proceeds an arm supporting two hands, each being provided with two series of fingers.

Reference and Synonymes.

G. CUMBERLAND, in Transactions of Geological Society, Vol. v. Pl. III.
fig. 1.

Locality.

At Clevedon, in the Magnesian beds of the Mountain Limestone; at Woodspring, Black Rock (14th bed of Dr. BRIGHT's series in Geological Transactions, Vol. IV.) near Bristol, in the same formation.

Observation.

The COLUMN (fig. 27. and 31.) of this species is of a round form, and its joints, particularly near the summit, having been very muscular externally, have their margin rounded inwards near the surface of articulation, evidently the result of contraction. The alimentary canal is near the pelvis subquangularis (fig. 20.) becoming round further from it (fig. 21.) The centre of the columnar joints is depressed and smooth, surrounded by a radiatingly striated rim towards the exterior.

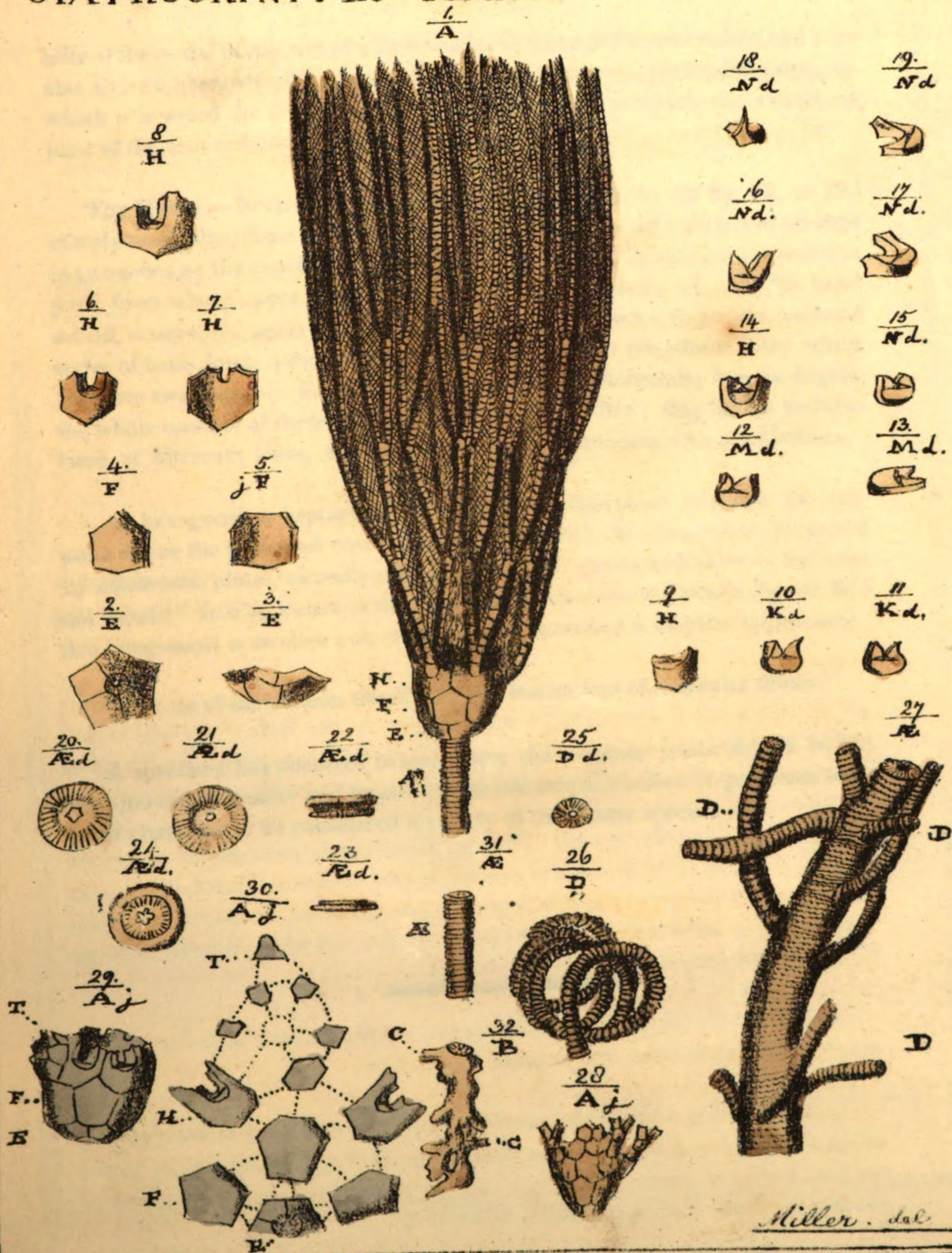
Round SIDE ARMS (fig. 25. and 27.) came off irregularly from the column, they are of considerable length, and must have possessed an high degree of muscularity, demonstrable by their frequently coiling up (fig. 26), and the margin of their joints being rounded inwards, as in the column.

The PELVIS (fig. 2. and 3.) is saucer-shaped, and composed of five plates, forming in the centre a subpentangular perforation, the entrance to the alimentary canal, which was probably once defended by a sphincter. At the inferior part, the pelvis is excavated for the firmer adhesion of the columnar joint, with which it corresponds in its striated markings.

The COSTALS. (fig. 4. and 5.) At the summit the plates of the pelvis are more or less angularly pointed, where, in the spaces thus formed, the costal plates insert. Four of these are subhexagonal (fig. 4.) and one is subheptagonal (fig. 5.) from having its superior angle truncated.

The SCAPULÆ (fig. 6. to 9. and 14.) which insert between the angular sum-

CYATHOCRINITES PLANUS



SYLLOGISMUS



mits of the costal plates, are of a form similar to those of *Poteriocrinites*, and have also above a horse-shoe-like impression, with a transverse, perforated ridge, on which is inserted the first arm joint (fig. 10. and 11.) to which the cuneiform joint of the arm articulates.

The HANDS.—Several horse-shoe-shaped joints (12. to 13. fig. 15. to 19.) closely resembling those of *Pentacrinus Caput Medusæ*, articulate and arrange in two series on the cuneiform joint. Each series has at its summit a cuneiform joint, from whose upper angular portion the two first series of a double hand set off, interrupted again by a cuneiform joint, from which a finger and a second series of hand joints proceed, terminated by another cuneiform joint which supports two fingers. Each hand, as far as I could ascertain, has six fingers, the whole number of them, therefore, amounts to sixty; they are all tentaculated at alternate sides, and resemble those of *Pentacrinus Caput Medusæ*.

An hexagonal or heptagonal plate generally interposes between the scapulæ where the truncated costal occurs, from which the integument, protected by calcareous plates, extends over the abdominal cavity and sulcy in the arms and hands. In a specimen in the Ashmolean collection at Oxford (fig. 29. 30.) this integument is swollen out, and gives the specimen a singular appearance.

The base of the column terminates in a fasciculum of muscular fibres.

A specimen has occurred to me, where the columnar joints (fig. 22. to 24.) are alternately smaller and larger. I am not aware whether it possesses sufficient character to be considered a variety of the former species.

Externally the arms, hands, and fingers, are ornamented with four or five longitudinal impressions, the result of contraction.

C. Stokes, Esq. of London, had the kindness to send me a drawing (fig. 2.) of the fingers of an *Eocrinus*, from Dalkey, which I apprehend belong to this species, and as it conveys a correct idea of the manner in which the animal contracted them, I have annexed a figure of it.

II. SPECIES. CYATHOCRINITES TUBERCULATUS.

TUBERCULATED, CUP-LIKE, LILY-SHAPED ANIMAL.

Specific Character.

A Crinoidal animal, having a column formed of round compressed joints with radiatingly-striated articulating surfaces; from each of the five scapulæ proceeds an arm supporting two hands. Externally tuberculated.

Locality.

Probably at Dudley, in Transition Limestone.

Description.

The specimen (fig. 1.) from which I have derived the specific character, was presented to me by T. SMITH, Esq. of Easton Gray, Gloucestershire, through the hands of the Rev. R. HALIFAX, of Standish.

It is very neat and small, indicating, however, that the species might probably increase to a considerable size. There is but little of the column left which adheres to the pelvis. The costa and scapulæ have each a double series of tubercles, arising from the contraction of the muscular integument in such a direction as might give motion to the arm, which is formed of two joints, a common and a cuneiform one. From this two hands proceed, in which the number of joints of the first series amount to two, supporting a cuneiform joint which, on one side gives rise to a finger, and on the other, to four or five joints continuing the hand and forming its second series, on whose summit a cuneiform joint adheres and sends off two fingers.

Externally the arms, hands, and fingers, are ornamented with four or five longitudinal impressions, the result of contraction.

C. STOKES, Esq. of London, had the kindness to send me a drawing (fig. 2.) of the fingers of an Encrinite, from Dudley, which I apprehend belong to this species, and as it conveys a correct idea of the manner in which the animal contracted them, I have annexed a figure of it.

CYATHOCRINITES

TUBERCULATUS

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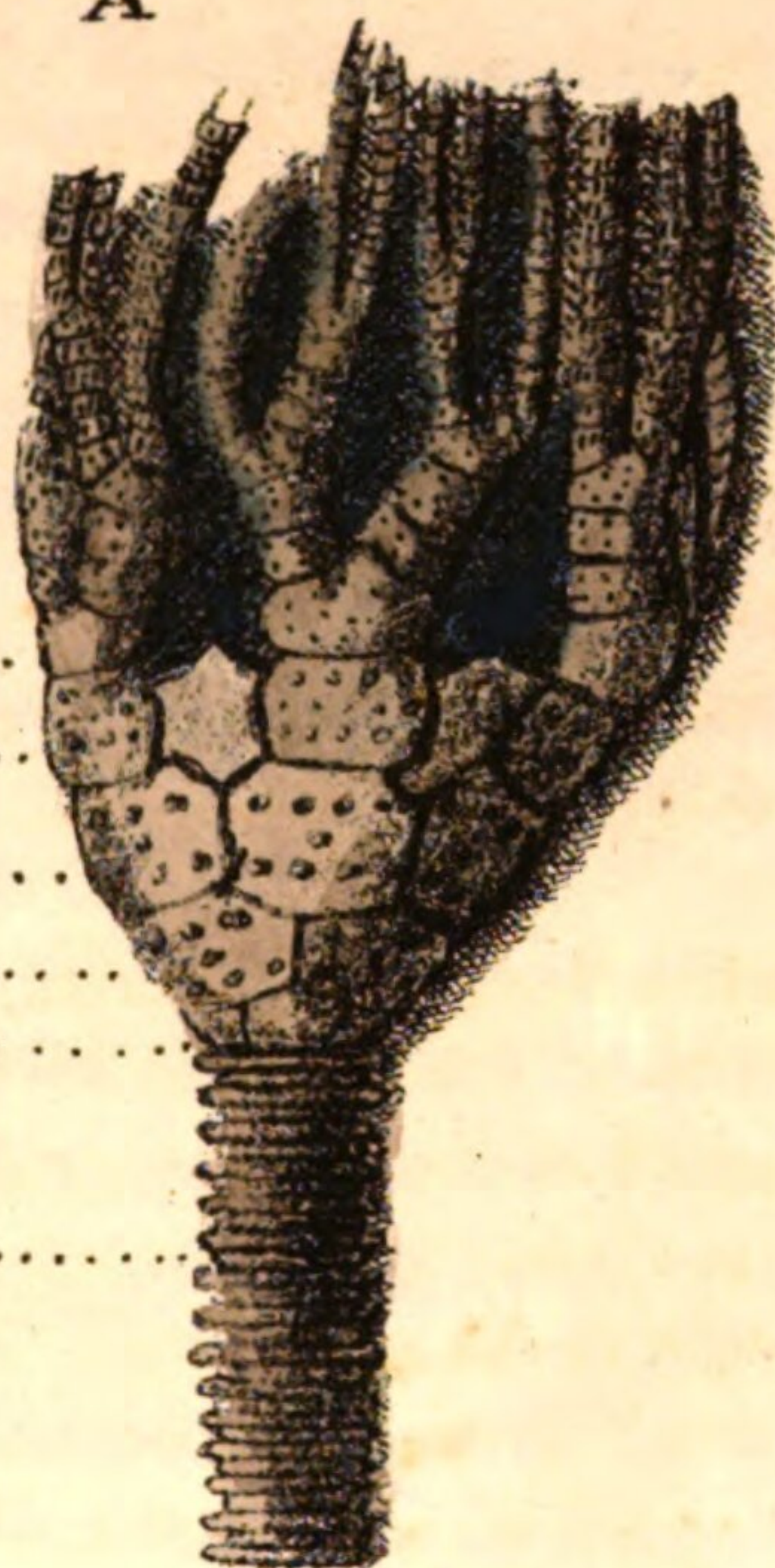
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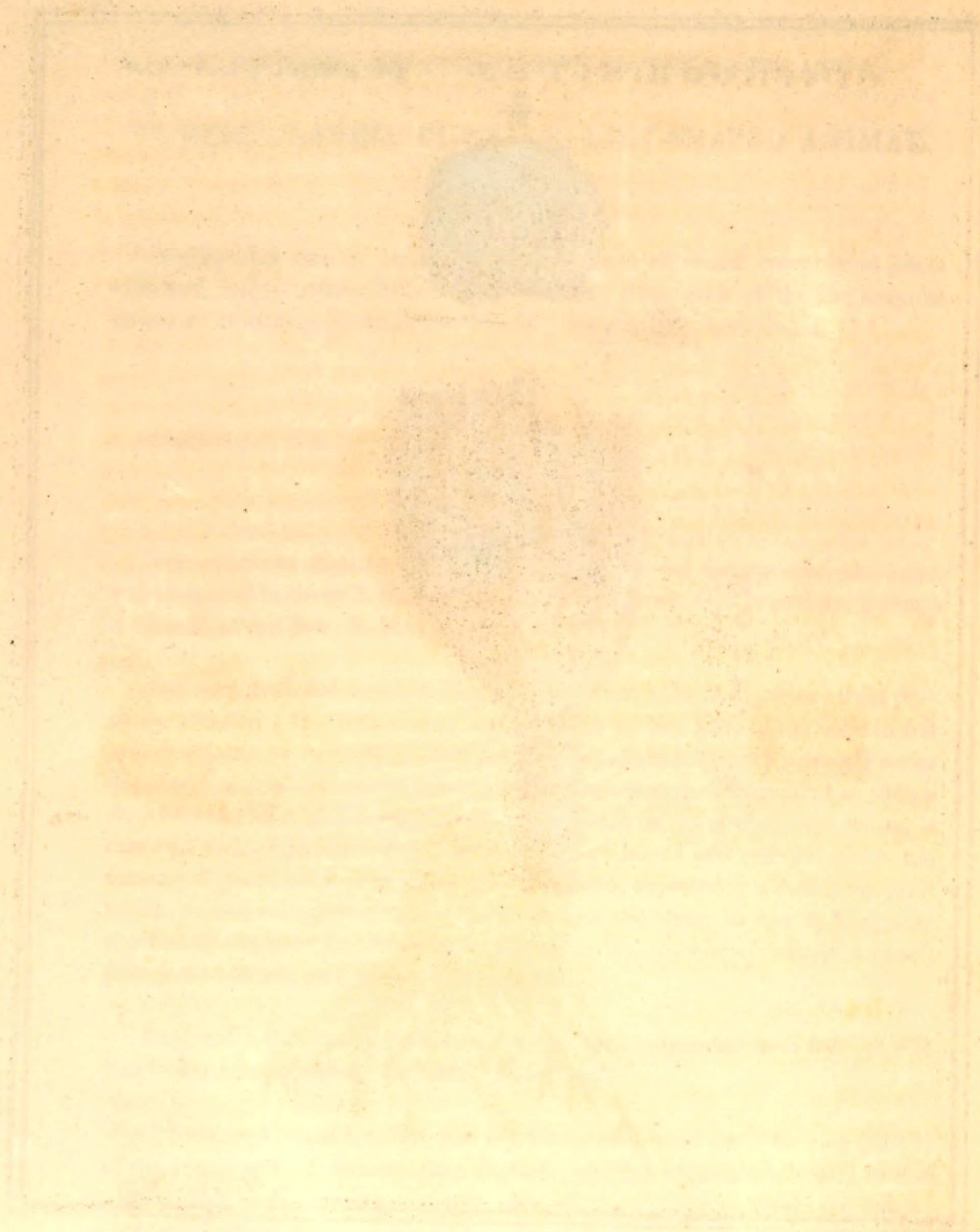
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W. H. Miller



III. SPECIES. CYATHOCRINITES RUGOSUS.

RUGGED, CUP-LIKE, LILY-SHAPED ANIMAL.

Specific Character.

A Crinoidal animal, having a column formed of numerous joints articulating by striated surfaces. The different plates forming the cup-like portion surmounting the first columnar joint, externally ornamented with deep, rugged, angular striæ. The base formed of numerous muscular fibres.

Reference and Synonymes.

KNORR.—Supl. 7. c. fig. 5.

PARKINSON'S Org. Remains, Vol. II. t. 15. fig. 4. and 5.

Locality.

In the beds of the Transition Limestone, in Shropshire, Herefordshire, the Islands of Oeland and Gothland, and in Dalecarlia.

Description.

It is a species which grows to a very large size, showing strong marks of great external muscularity.

The COLUMN (fig. 2.) is formed of considerably compressed joints, having in the centre a pentapetalous passage for the alimentary canal, and articulating surfaces marked by radiating striæ. They are alternately smaller and larger, having their surfaces somewhat undulated, which becomes more conspicuous

near the base, showing at the circumference a swelling out of the surrounding muscular covering, forming more or less regular and conspicuous tubercles perforated at their summit. These are sometimes elongated into fibres, branching and dividing at intervals. The tubercles have at their summit a round perforation, which extends through their middle when they are elongated into fibres. It is difficult to explain of what utility they are to the animal, unless we consider them as secreting tubes, or as feelers by which the animal might have explored substances near it.

The BASE. (fig. 4.) The elongated subdividing fibres proceeding abundantly from the lower portion of the column, form a kind of fascicular or rather root-like base, and where two or more individuals occur near each other, these fibres appear to have lost their muscularity, to have exuded calcareous matter, or become themselves gradually converted into it; and being no longer of utility to the animal in any other way, they have become connected with the contiguous individuals, forming with them one substance (fig. 3.) the animals so uniting, in consequence losing their locomotive power.

The PELVIS is formed of five plates, is hollowed out at the bottom for the reception of the upper columnar joint, adhering to it by its radiatingly striated surface, and perforated in the centre for the pentapetalous passage of the alimentary canal. The outer rim of its five plates bends upwards, forming a sort of saucer, each plate being angularly pointed at its superior edge.

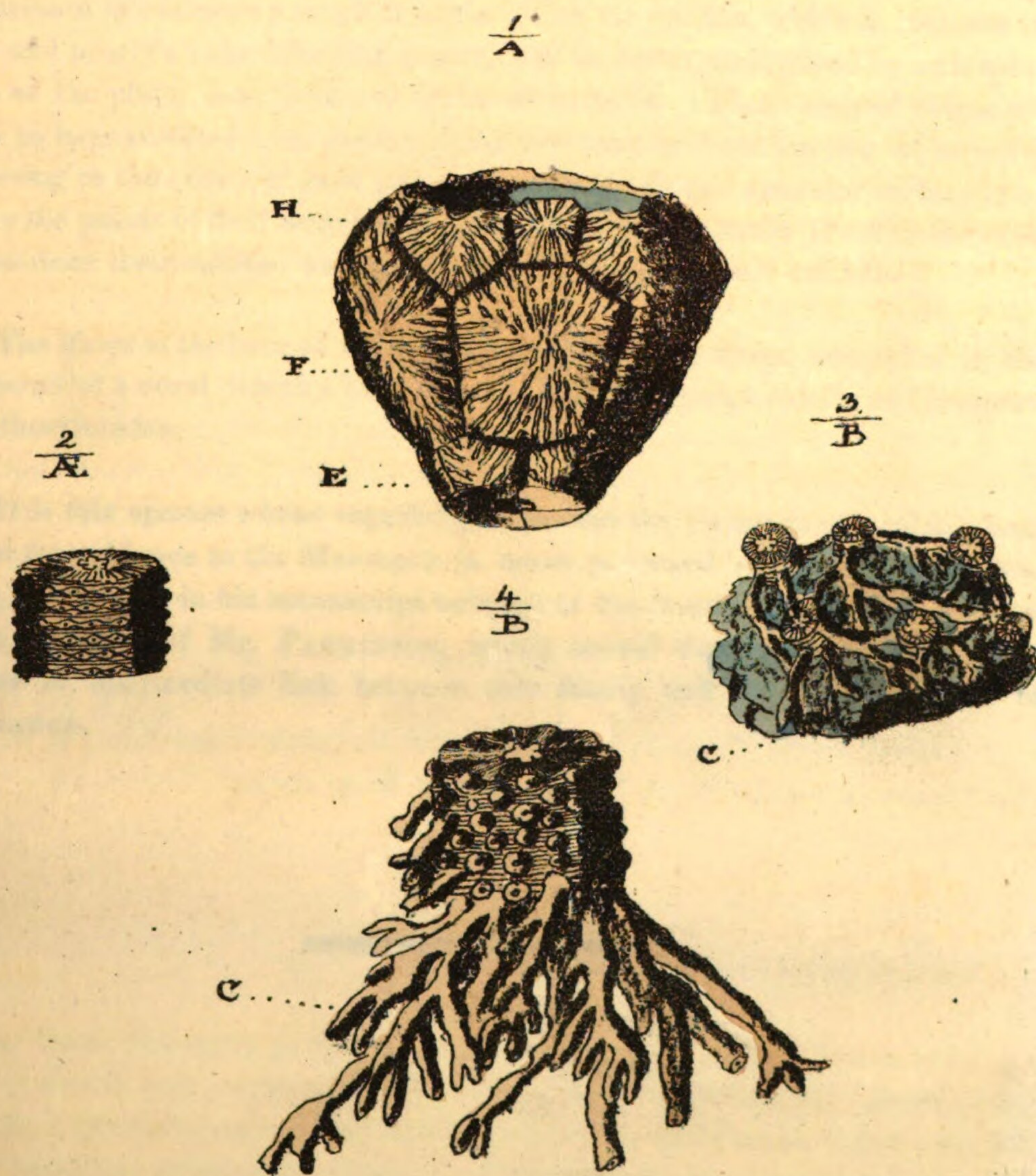
The FIVE COSTÆ are inserted in the angular spaces formed by the pelvis, four of them are hexagonal, and one is heptagonal, having its summit partly truncated, to which a small hexagonal plate adheres.

The SCAPULÆ are inserted in the angles formed at the upper edge by the costæ, having at their summit a horse-shoe-like depression for the articulation of the arm joints.

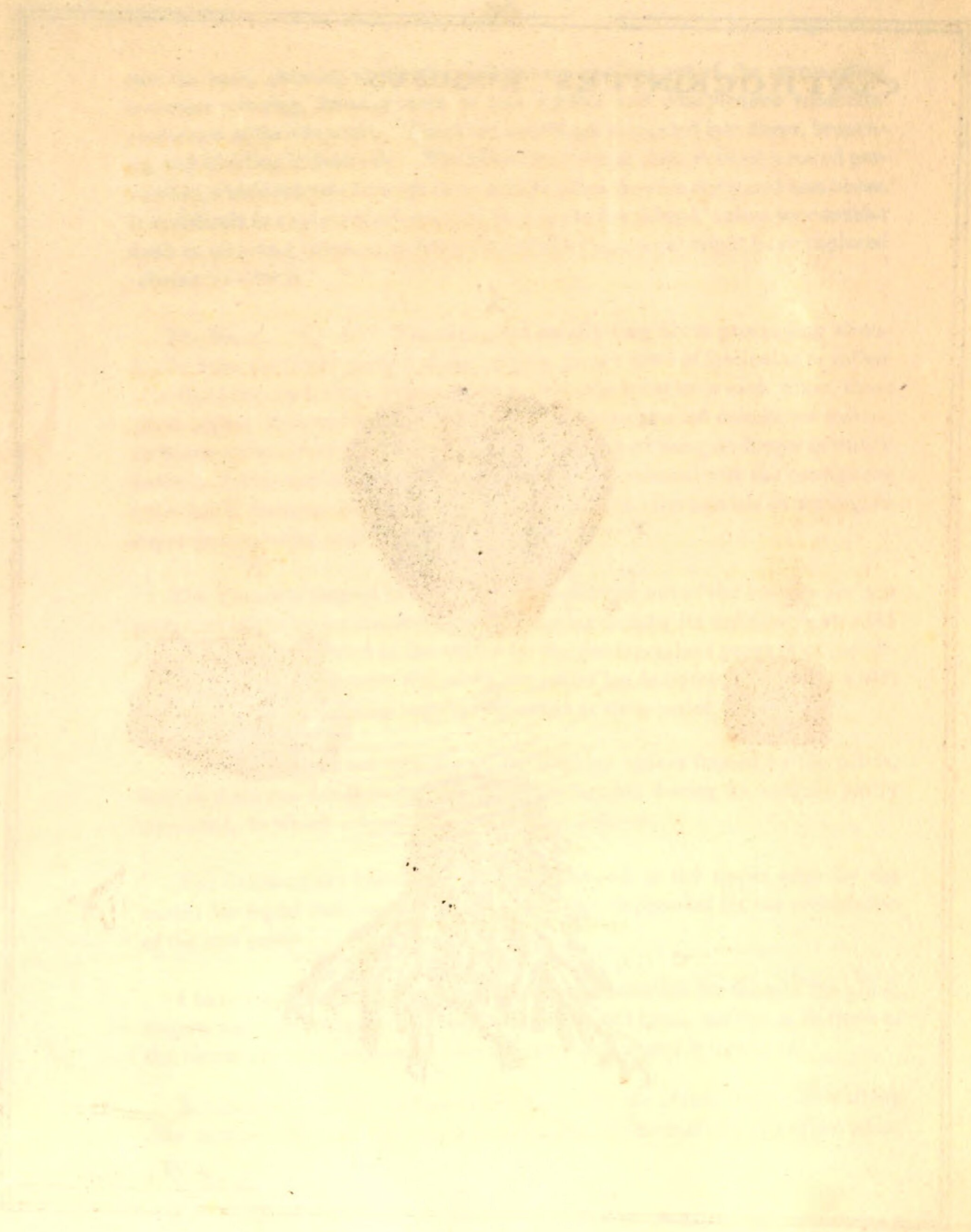
I have not seen a specimen by which I could ascertain the form of the arms, fingers, and tentacula; but believe them in general form, analogous to those of the former species, possessing also the muscular plated integument.

Externally the outer surface of the portion of the plates of the pelvis where they are turned up, the costæ and scapulæ (fig. 1.) are marked by rugged striæ.

CYATHOCRINITES RUGOSUS



Miller. del



The disposition of these striæ is as follows; from the centre of each plate a ridge proceeds to each side of the polygon formed by it, bisecting each of the triangular areas into which it may be resolved; all the other striæ contained in each of these areas are parallel to this first. (See fig. 1.) The configuration of the contiguous plates being similar and adapted to each other, the markings proceed over them in the same direction, thus producing a series of triangular striæ, arranged in such a manner that the ramifications from three contiguous plates contribute to compose a single triangle. This disposition, which is common to this and nearly all the following genera, will be better understood by an inspection of the plate, than from any verbal description. These rugged ridges appear to have resulted from the ramifying structure and contraction of muscles adhering to the centre of each plate, where a rough and granular surface indicates the points of their attachment, and thence acting partly towards the arms to produce their motion, and partly towards the pelvis and column.

The fibres at the base of this animal are frequently found entangled in the branches of a coral, which I have called in my manuscript catalogue *Hexapora Cyathocrinoidea*.

It is this species whose superior portion and the markings of its plates bear great resemblance to the *Marsupite* (a name proposed by GIDEON MANTELL, Esq. of Lewes, in his manuscript account of the Southdown fossils), or *Tortoise Encrinite* of Mr. PARKINSON, which animal forms the approximating genus or intermediate link between this family and the genus *Euriale* of LAMARCK.

IV. SPECIES. CYATHOCRINITES QUINQUANGULARIS.

FIVE-CORNERED, CUP-LIKE, LILY-SHAPED ANIMAL.

Specific Character.

A Crinoidal animal, with a pentagonal column, whose joints adhere by an elevated striated rim, enclosing a pentagonal depression with a similar-shaped central column. The cup-like portion, formed by plates surmounting the column, sending off five arms.

Locality.

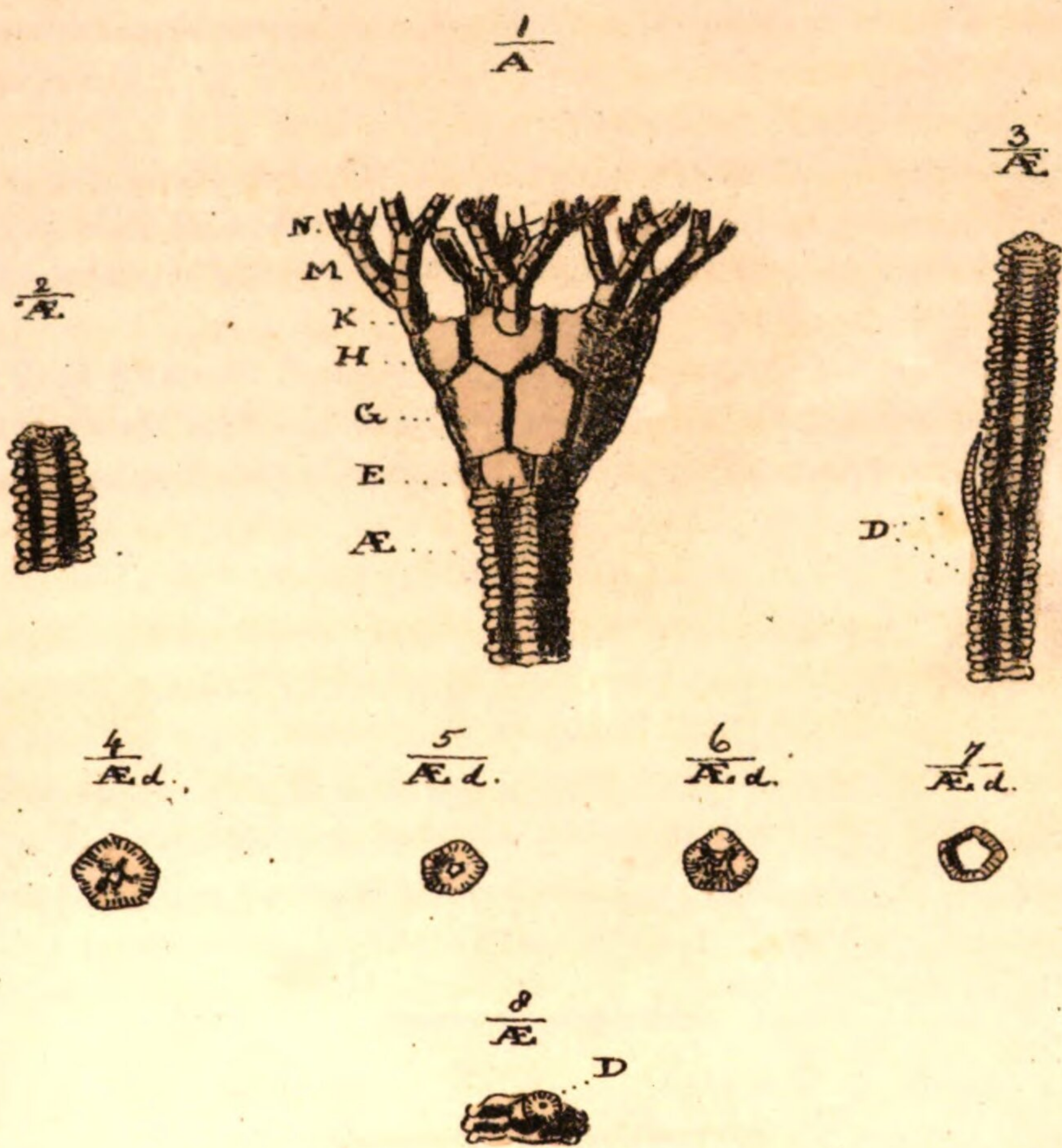
Clevedon, in the Magnesian variety of the Mountain Limestone; in Mountain Limestone, at the Black Rock, near the River Avon.

Description.

A comparatively small species.

The COLUMN (fig. 2. to 8.) is formed of alternating large and small pentagonal joints, the former being also thicker than the latter, and drawn in near the line of their adhesion to each other. Their centre is perforated by a subpentagonal alimentary canal, surrounded by a similar depression, enclosed by a striated rim, which articulates with a similar one on the joint above it. The angles of the alimentary canal do not coincide with those of the column, but

CYATHOCRINITES QUINQUANGULARIS.



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are directed to the space between them. The sphincter muscle, which probably exists near the canal, having points of adhesion at each of its five corners, sends off its dividing fibres across the smooth area to adhere to the striated rim, thereby effecting the movement of the column: hence the striæ at the outer margin do not incline to the centre.

The **AUXILIARY SIDE ARMS** (fig. 3. and 8.) are formed of numerous round joints, proceeding at irregular intervals from the spaces between the angles of the larger joints.

The **CUP-LIKE PORTION** (fig. 1.) on the summit of the column is formed by plates resembling those of *Cyathocrinites Planus*, except that the lower surface of the pelvis, where it articulates to the column, is somewhat pentagonal.

The **FIVE ARMS** are formed of one-arm joint and a cuneiform one, supporting two hands, each composed of two joints, and a cuneiform one sending off a finger, and probably also another series of the hand joints.

VIII. GENUS, ACTINOCRINITES,
 RADIATED, LILY-SHAPED ANIMAL.

Generic Character.

A Crinoidal animal, with a round column composed of numerous joints, perforated by a round alimentary canal. At the summit of the column is placed a pelvis formed of three plates, on which five first costals and one irregular costal adhere; which are succeeded by the second costals and intercostals and the scapulæ, from whence five arms proceed, forming two hands, with several tentaculated fingers.

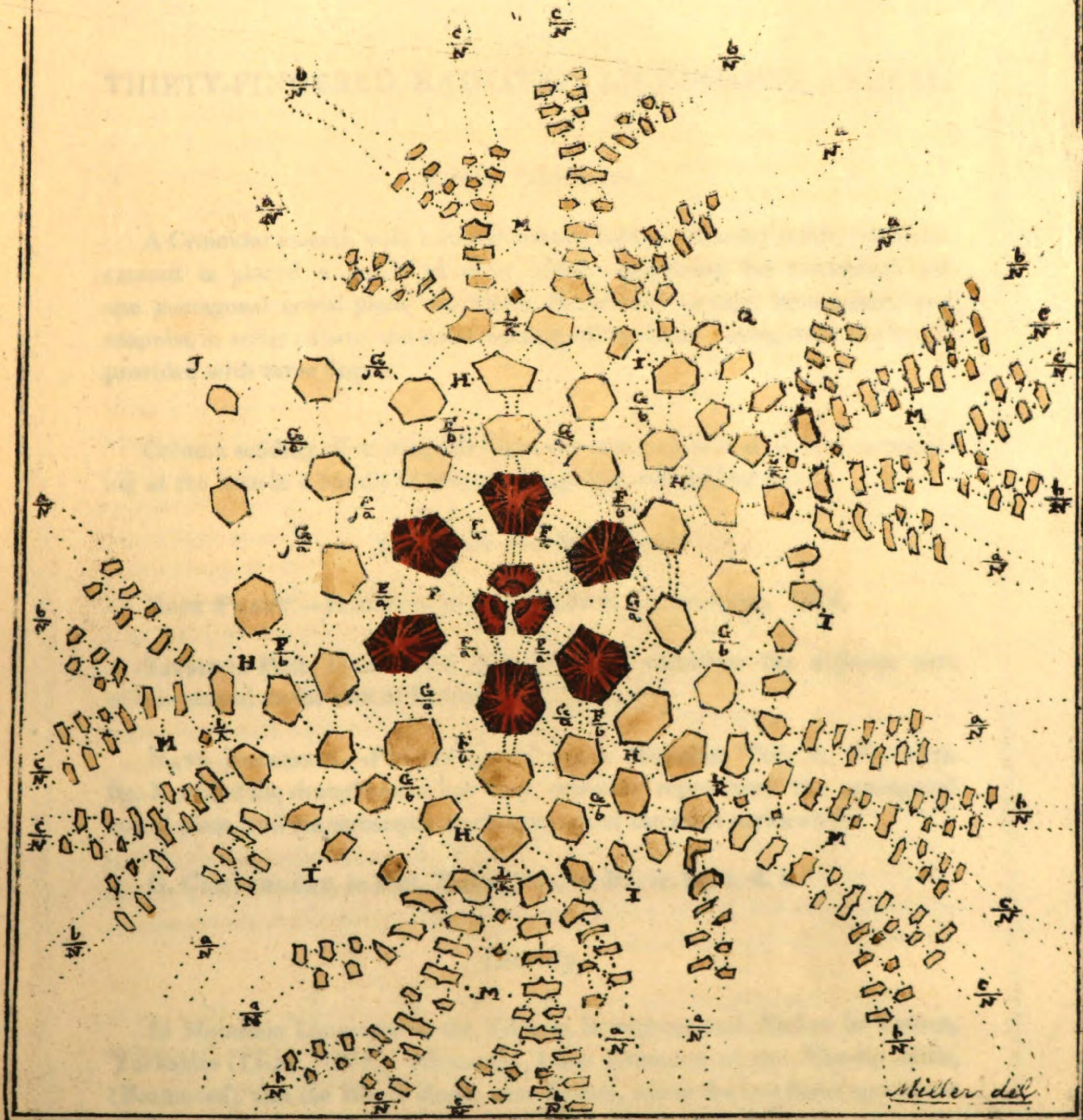
Round Side Arms proceed at irregular distances from the column, which terminates at the base in a fascicular bundle or root of fibres.

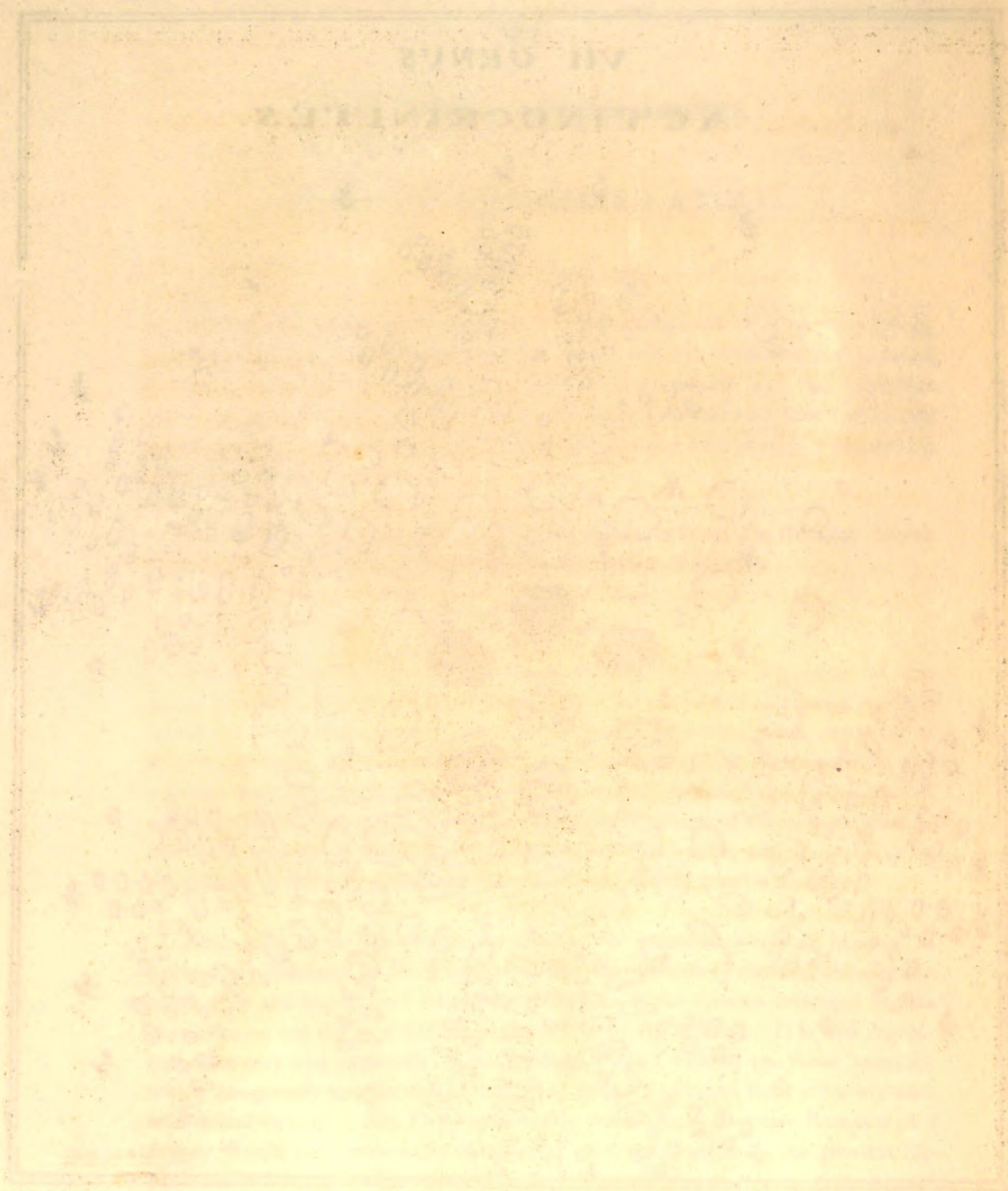
Observation.

The Greek ΑΚΤΙΣ, whence ΑΚΤΙΝΩΤΟΣ, radiated, furnishes the name of this genus in reference to the radiated markings of the costal and intercostal plates, which are peculiarly conspicuous in this genus. When the arms deprived of their fingers project laterally from the subglobose body at the summit of the column, they bear some resemblance to the rays or spokes fixed in the nave of a wheel; from whence Mr. PARKINSON applied the name of Nave Encrinite, to one of the species of the animals belonging to this genus, which also may be considered to have an additional allusion to the Greek generic name.

None have as yet been found recent, and the scientific world, I believe, is exclusively indebted to Mr. PARKINSON for the discovery that the subglobose body, with the fingers and tentacula attached, of the species arranged in this genus, forms not the root but superior portion of the animal. It is this ingenious discovery and exposure of an error of former writers on these animals, which has greatly contributed to the better understanding of their economy and anatomical details. Mr. PARKINSON's able work on the Organic Remains of a former World must indeed be considered as a publication of the greatest importance in the study of these remains, and in particular as having given a great impulse in England to their investigation.

VII. GENUS.
ACTINOCRINITES.





I. SPECIES. ACTINOCRINITES TRIACONTA DACTYLUS.

THIRTY-FINGERED, RADIATED, LILY-SHAPED ANIMAL.

Specific Character.

A Crinoidal animal, with a round column formed of many joints, on whose summit is placed a pelvis of three plates supporting five hexagonal and one pentagonal costal plate, on which the second costals, intercostals, and scapulæ, in series adhere, the latter sending off five arms, having each two hands provided with three fingers.

Column sending off at irregular distances auxiliary side arms, and terminating at the base in a bundle of fibrous elongations resembling roots.

Reference and Synonymes.

ROCK PLANT.—Beaumont in Philosophical Transactions, 1676.

LISTER in Phil. Trans. 1674. No. 100, who considers the superior part of this animal as the root of Entrochi.

NAVE ENCRINITE.—PARKINSON'S Organic Remains, VOL. II. PL. XVII. fig. 3. where the draughtsman has very correctly represented the pentagonal costal plate, and the subsequent arrangement of the other series on it.

G. CUMBERLAND, in Phil. Trans. VOL. V. PL. II. fig. 1. 4. 5.

Locality.

In Mountain Limestone at the Villages Broughton and Stokes in Craven, Yorkshire (Lister, 1674.) Mountain Lime formation of the Mendip Hills, (Beaumont), and the Black Rock, near Bristol, where the two finest specimens of this species in my collection were found by Mr. JAMES BENTON, an intelli-

gent collector and dealer in fossils, to whose zeal and integrity in collecting and preserving all Crinoidal remains which fell under his observation, I am much indebted for acquiring a series of highly illustrative specimens.

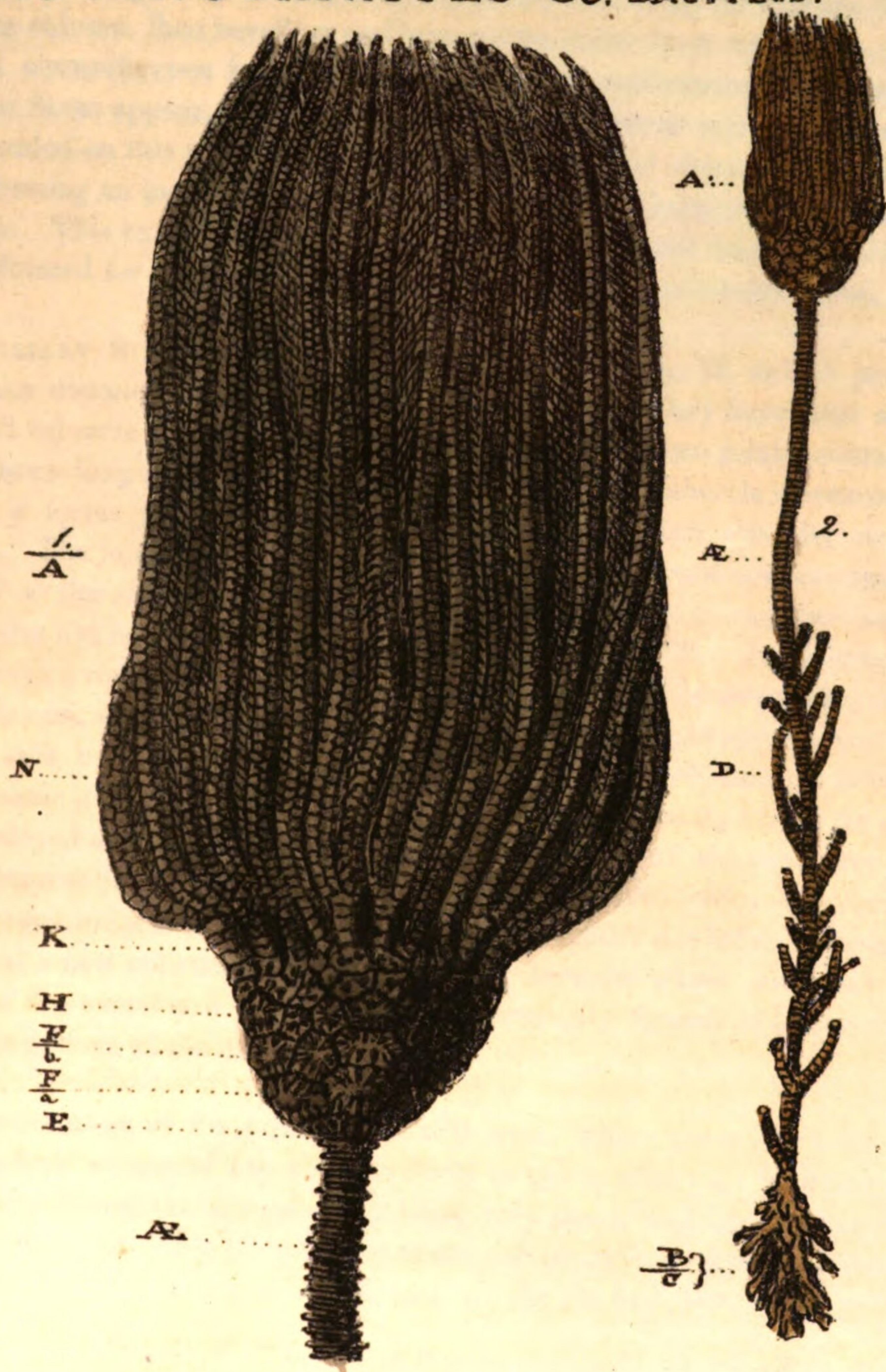
Description.

The COLUMN (PL. I. fig. 1. PL. VI. fig. 1. to 22.) of this animal, is near the pelvis formed of very thin joints, alternately a little longer and thicker, with a still larger one intervening every second or third joint. This regularity is interrupted further down by the intervention of four or five small joints, all appearing muscular, and as if they had not yet acquired solidity by the secretion of calcareous matter, which I consider as a proof of the formation and interposing of new joints during the life of the animal between those already existing. Still lower down the column the joints become of a more uniform thickness and size, and vary but very little. In an early stage of growth they are externally much contracted near the margin of adhesion, thence somewhat moniliform, which form is continued when they increase in size, though less conspicuously showing itself, sometimes only in a slight central elevation. The articulating surface of the joints (PL. VI. fig. 1. 3. 5.) is very regularly striated or grooved in radii, from the middle, producing externally a most regular and beautiful suture of mutual insertion. (PL. VI. fig. 15.) Near the centre they are excavated on both sides, forming a muscular edge, which surrounds the alimentary canal. In sections we may sometimes see the alimentary canal of a considerable size (PL. VI. fig. 14. and 16.) and not unfrequently observe it at regular intervals more or less alternately contracted and dilated, yet always leaving a large passage open. It is from the increased size of the alimentary canal in columns of larger diameter, that I apprehend the epidermis or periosteum, whose usual office was to secrete the calcareous matter forming the joints, had also the power of absorbing and removing it; for, without this, the passage for the alimentary canal could not be enlarged, unless we indeed could admit that the induration of the calcareous matter forming the joints did not take place till the animal was full grown, which, however, is quite contrary to the operations of nature in the other Crinoidea.

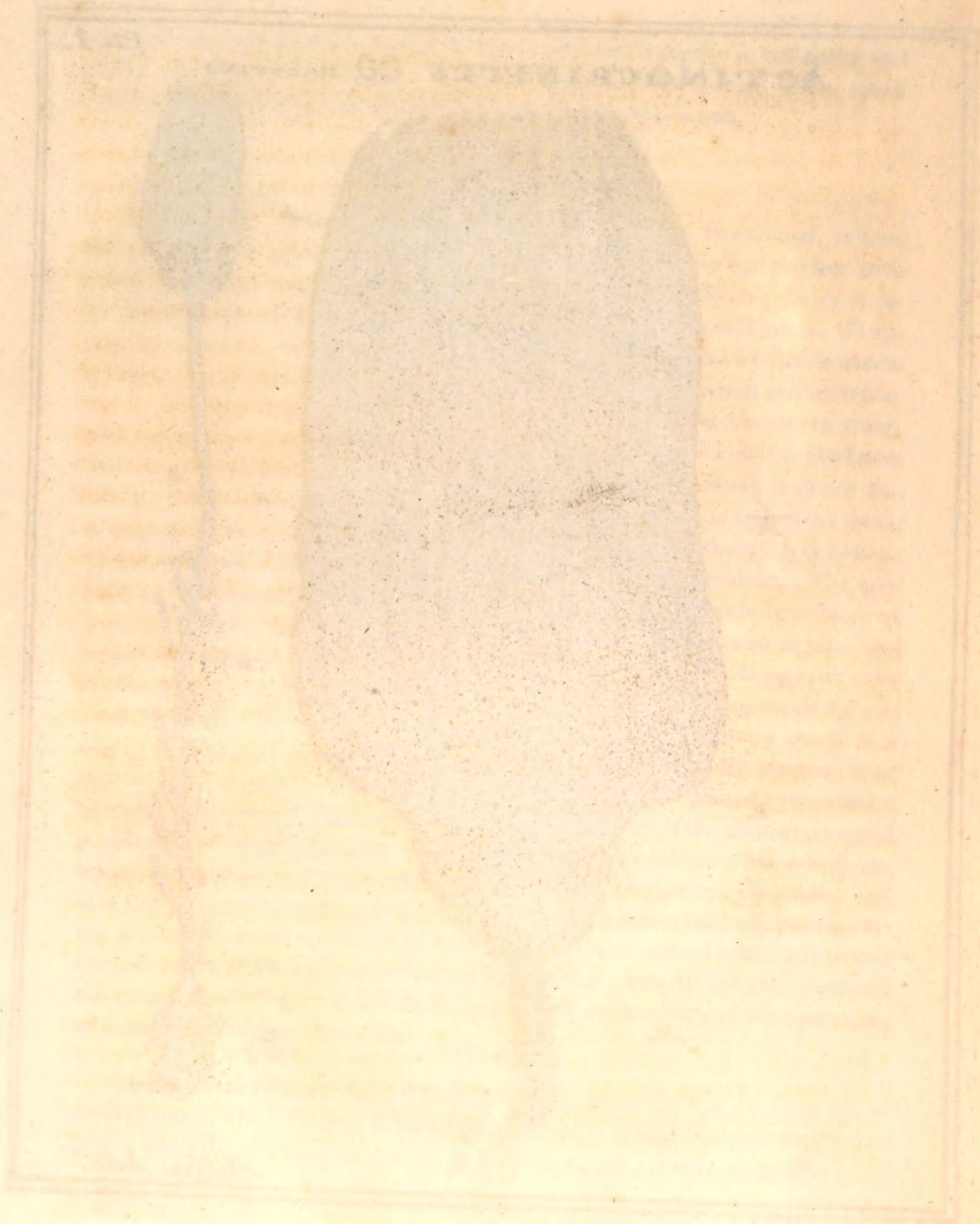
The COLUMN (PL. VI. fig. 17. to 22.) sometimes exhibits a swelling out of several joints, which renders it barrel-shaped, and a lateral concave depression with a central perforation as noticed in *Poteriocrinites crassus*, page 69.

ACTINOCRINITES 30. DACTYLUS.

PL. 1.



Miller del.



At the BASE (PL. VI. fig. 23. to 27.) of the column, the joints articulate similarly, but are irregularly waved; sometimes only extending for half the diameter of the column, then bevelling and insinuating under those near them. Their external circumference is here marked by small perforations, from whence muscular fibres appear to have protruded. A calcareous secretion has sometimes exuded on this part, surrounded the column, and concealed its articulation, forming an inorganic investing mass, as appears on examining transverse fractures. This exudation sometimes swells out into large knobs, which are also perforated for the insertion of the before-mentioned muscular fibres.

AUXILIARY SIDE ARMS* (PL. Actinocrinites lævis fig. 28. to 39.) proceed at irregular distances occasionally from the column. They have their origin in a small tubercle (fig. 28.) placed at the articulation of two joints, containing a vessel branching off from the alimentary canal; as this tubercle increases and extends, it forms joints in its progress articulating to each other by striated surfaces. The joints near the column produce in it a round concave impression, and as the side arms increase in size, this impression expands until it spreads over five or even more columnar joints (fig. 31. to 33.) In the progress of its growth a very remarkable circumstance takes place; the nourishing vessel of the side arm, which appears in the early stage of growth to communicate, as has been said, with the alimentary canal by passing along the interval between two columnar joints (fig. 28. 29. to 36.) may now be distinctly traced (in some well preserved specimens), passing through the middle of the substance of a single columnar joint. (Fig. 31. and 39.) If this observation can be relied on (which the minuteness of younger specimens may render doubtful) it distinctly proves that a new columnar joint (that namely through whose substance the channel of the vessel now passes), has been gradually formed and interposed during the growth of the animal.

The mechanism of the joints of the side arms, where these insert into the column, is well worthy of notice, particularly in old specimens. In the earlier stage of their formation, the side arms being very short, and having then little weight, a less firm mode of adhesion to the column than becomes requisite at a subsequent period, being then sufficient, we do not find more than one joint

* The Auxiliary side arms of *Actinocrinites lævis* are conformable to this species, hence I refer to that plate.

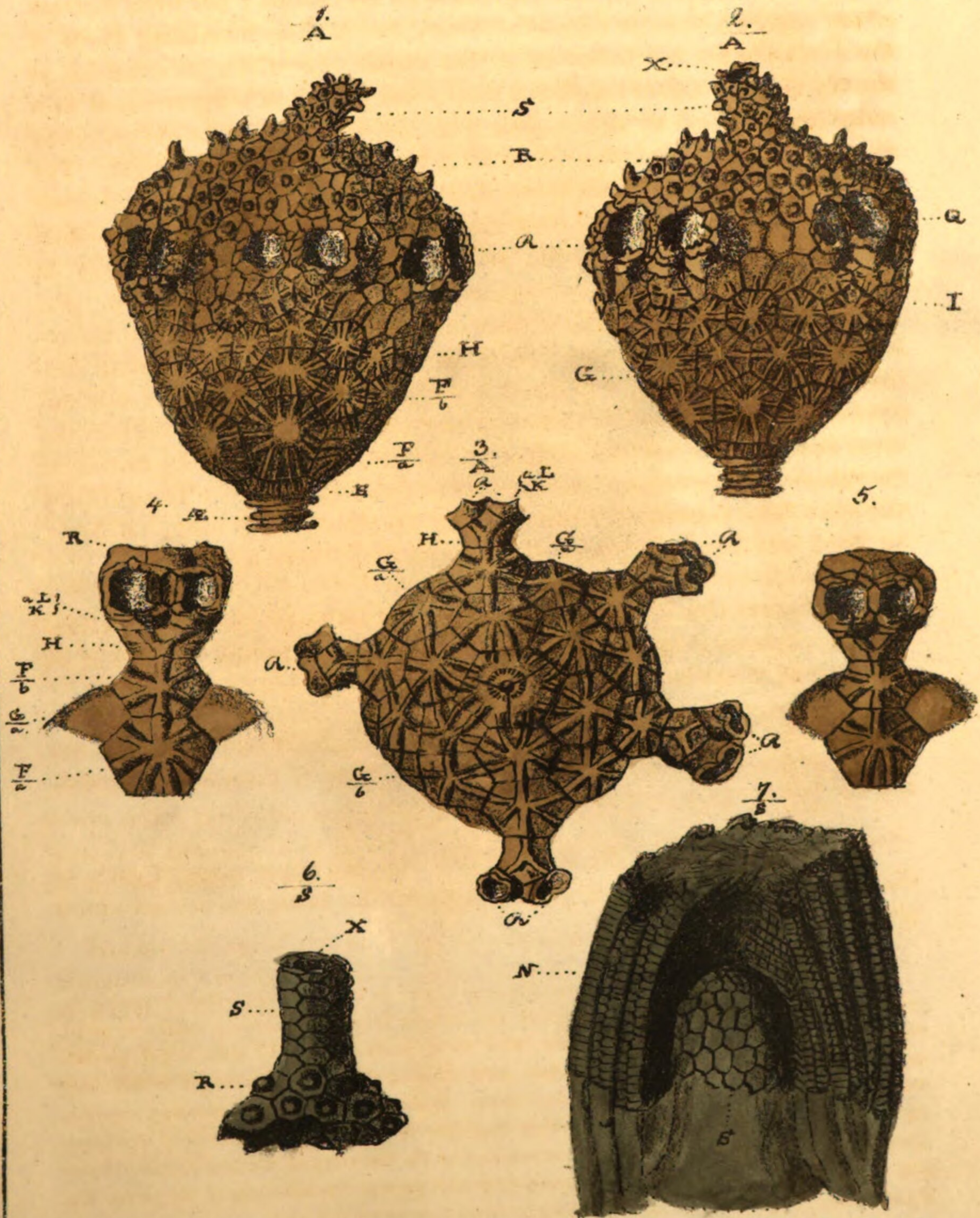
lodged in a socket or concave impression on the column ; but when increase of size renders a stronger support necessary, two or three succeeding joints of the side arms become imbedded in this socket, (for which its extension as already noticed, allows room) and these joints instead of being arranged in a series branching off at right angles from the column, become oblique, their direction inclining upwards so as to aid in bearing the additional weight. The first joint of the side arms where thus obliquely inserted in the columnar socket have that portion of their circumference which is presented towards the upper part of the column, truncated, in such a curve as may fit them to the concavity of the impression where they rest against it. (PL. A. *lævis*, fig. 29. to 33.) The surface of these joints which fit into the columnar impression is smooth (PL. A. *lævis*, fig. 31. 34. and 38.) being destined for adhesion only, but the articulating surface between the contiguous joints (fig. 32. 33. and 35.) where motion also is to be allowed, exhibits the usual mechanism of radiated ridges and furrows. These joints are convex on the side nearest the column, and concave on that most remote. The auxiliary side arms have sometimes others laterally branching from them, (A. *lævis*, fig. 30.) I have, however, never been able to ascertain their termination.*

The PELVIS (PL. III. fig. 1. to 8.) is formed of three plates and saucer-shaped, presenting at its upper edge six depressions for the adhesion of as many plates of the next series.

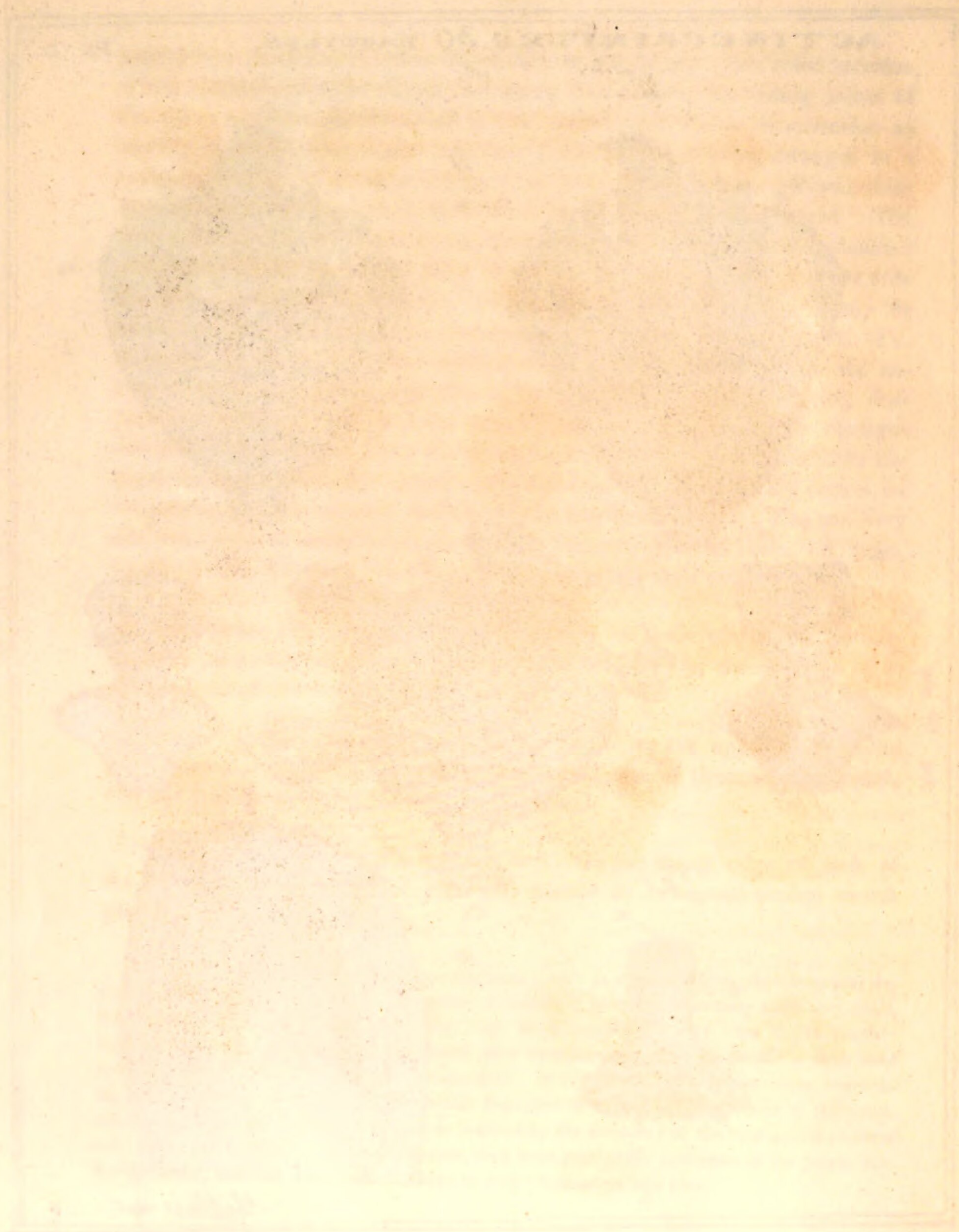
The SIX FIRST COSTALS (PL. II. fig. 3.) adhere to the upper edge of the pelvis, are plate-like, and of two distinct forms ; five of them are hexagonal, and one (the irregular first costal) is pentagonal.

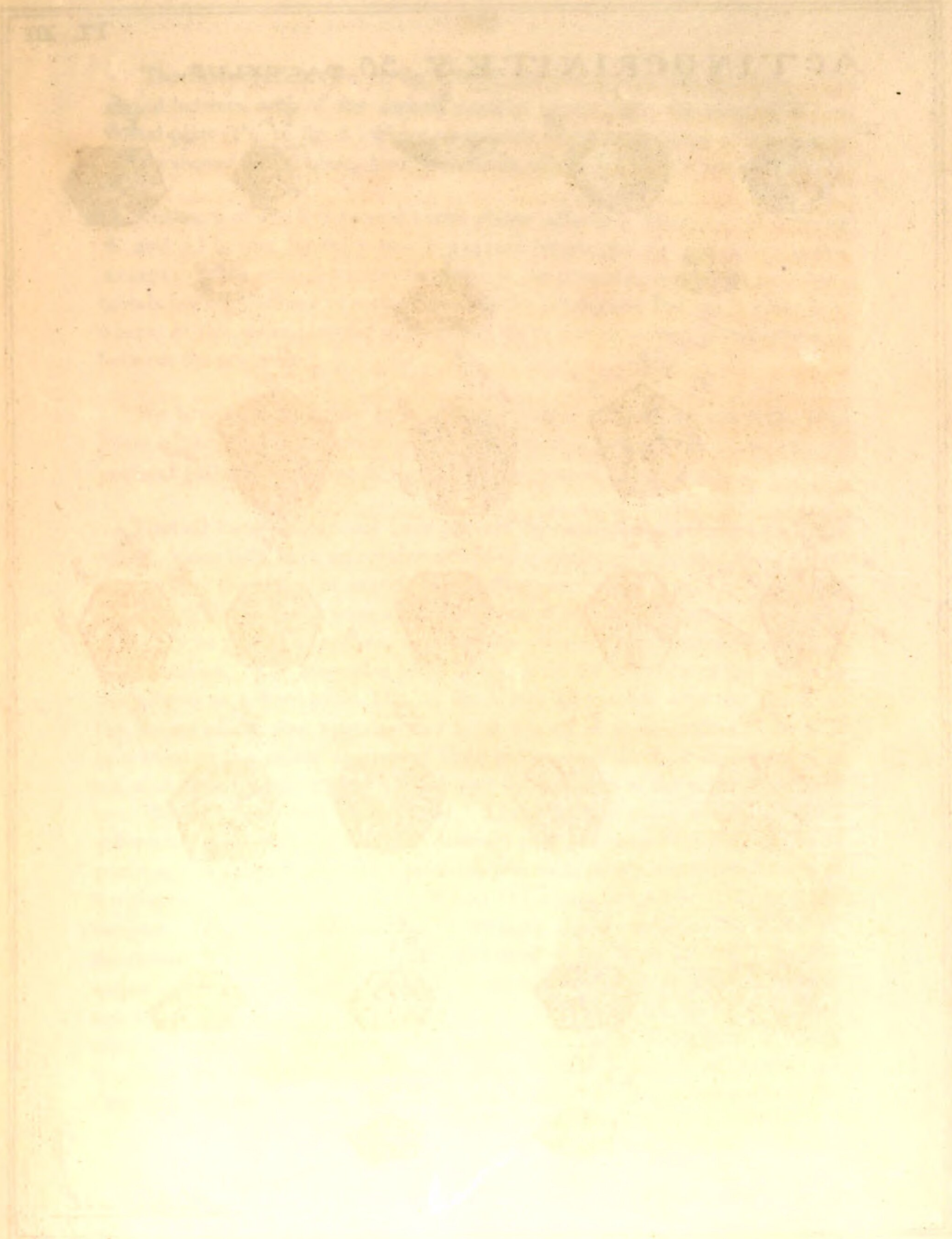
The SECOND COSTALS. (PL. II. fig. 3. to 5.) On the upper edge of each of the five hexagonal first costal plates, is placed an hexagonal second costal plate.

* Since the mode of insertion of these side arms is such as would facilitate their becoming detached, and the vessel by which they receive nourishment from the alimentary canal very small, the idea once suggested itself to my mind, that these complicated side arms might possibly be the rudiments of young animals, which after drawing their nourishment for a time only from the parent, drop off and become independent. In our present state of ignorance concerning the propagation of these animals, it seems improper to suppress the statement of this possibility, which would at once be confirmed or confuted by the discovery of the termination of these side arms ; since, if the conjecture is correct, they must present the rudiments of the pelvis, &c. On the whole, however, I am rather inclined to reject than adopt this idea.



Miller del.



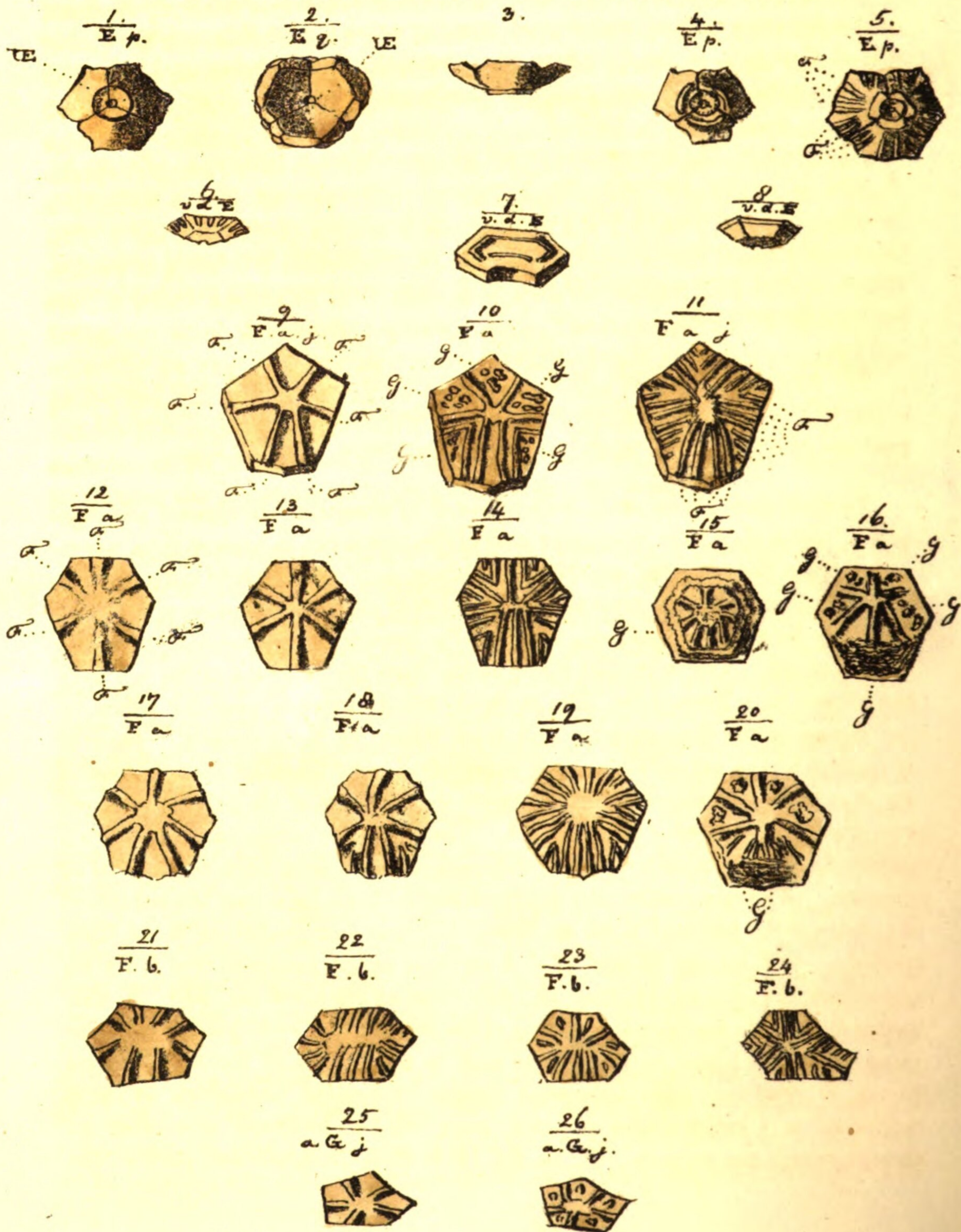


II

ACTIVITIES TO BE COMPLETED

II

ACTINOCRINITES 30. DACTYLUS.



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The INTERCOSTALS (PL. II. fig. 1. to 3.) are pentagonal, one of them is inserted between each of the second costals, except over the pentagonal first costal plate (PL. II. fig. 2.) where on account of its angle being unable to support a second costal plate, two intercostals adhere laterally to each other.

On each of the five second costal plates adheres a SCAPULA, (PL. II. fig. 4. and 5.) having laterally two hexagonal interscapular plates interposed, except over the enlarged interval, where, in the preceding series, the two intercostals laterally adhere to each other over the pentagonal first costal plate, and where, in this series, instead of two only, three interscapular plates intervene between the scapulæ.

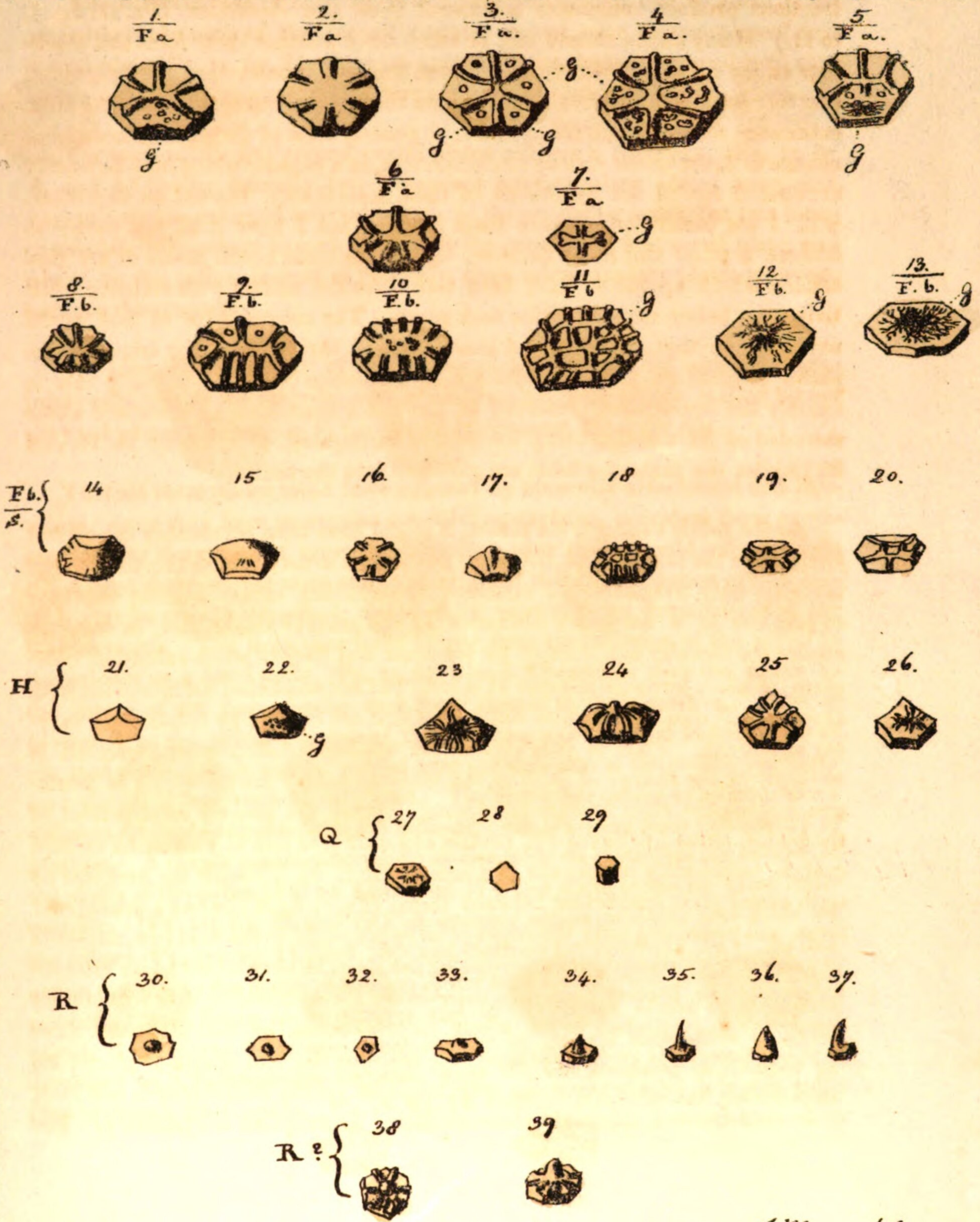
We have thus the figure of a cup completely formed, of which the arm-joints adhering to the scapulæ, and several multangular pieces (called by me pectoral plates) belonging to the plated integument, form the rim.

That all these plates must have adhered by muscular attachment and ligaments, since they have no regular articulating surfaces, is evident from necessity. That the action of muscles extending over them, could only produce the pulling down of the arms and contraction of the upper portion of the animal, may be readily supposed, and is fully proved by an examination of the fossil remains. The muscular force acting from the adhesion of the pelvis to the column as a fixed point, (PL. II. fig. 1. and 2.) extends over the pelvis to the suture of the first costals, and from thence to their centres. Now it is evident as the pelvis consists of three pieces, and the first costal series of six, that three costals will be placed over the divisions of the pelvis, and three over the middle of each of its plates. The muscular action exhibits hence a different form of contraction on the different costals arising from this variety of position. A simple contraction produces two folds on those over the sutures of the plates of the pelvis (PL. III. fig. 9. and 17.) and a single one on those intermediate. (PL. III. fig. 12. and 13.) A stronger action produces four folds on the former (PL. III. fig. 11. and 18.) and three on the latter (fig. 14.) As this action extends to the central adhesion of the muscles on each plate, and communicates from hence to its sutures and to the centres of the approximate plates, it produces folds somewhat similar in general disposition to those described in *Cyathocrinites rugosus*, page 90, but lessening in number as they approach the scapula. (PL. IV. fig. 14. to 26.) Irregular and partial con-

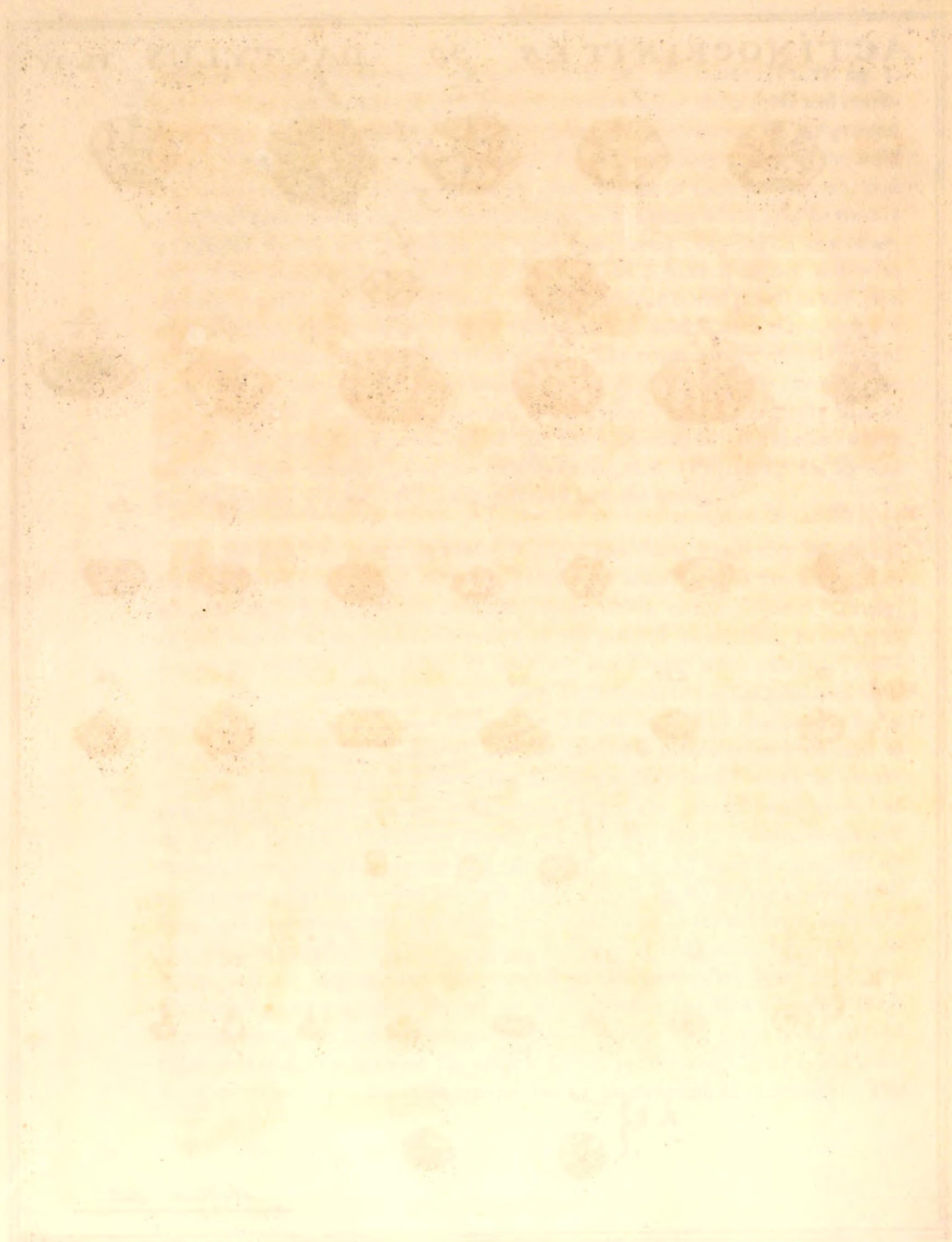
tractions produce sometimes additional folds and elevations. (PL. IV. fig. 1. to 11.) If any doubt should still be entertained whether these folds and markings on the plates are really derived from muscular contraction, on the ground that they may have possibly resulted from the original configuration of the solid calcareous matter which forms them; a general view of their phenomena, and change of figure under various circumstances, in a manner which may be readily accounted for on the hypothesis of their muscularity, but not on any other, will, I am persuaded, remove these doubts; but I have it in my power to adduce a proof still more decisive. There are some costal plates in my possession which appear to have been torn from the animal with violence while living, or before decomposition took place. The consequence of this would naturally be that the lacerated muscle would shrink from the edges of the plates towards its point of adhesion in the centre; and accordingly this is exactly the appearance preserved in the fossil specimens; the surface where denuded of its muscle, being irregularly corrugated, (PL. III. fig. 15. 16. and 20.) whilst the muscular folds are gathered into the centre.

As the pelvis supports six plates, it might have been reasonably concluded that it was the intention of nature to sustain six arms; and as the animal has actually only five, that the omission must either create a great vacancy, or give rise to a necessary alteration of the general mechanism, in order to render the circular net, formed by the arms and fingers when extended, complete. Nature however is never at a loss, but accomplishes her purposes with ease, notwithstanding the new difficulties that are created by continually varying structures. Thus in this animal the apparent difficulty so presented is obviated by the change of form in the supernumerary costal which is pentagonal, while the other five are hexagonal. From the general arrangement of the plates, these five hexagonal costals can only give rise to a series of second costals, terminating in scapulæ and arms, (PL. II. fig. 1.) while the irregular or sixth costal plate intervening between them, (PL. II. fig. 2.) having a pentagonal form, and presenting only the edges of its upper angle to the next row, supports two series of intercostal plates occupying the interval, occasioned by its interpolation, and so formed that this interval in the succeeding rows gradually diminishes in proportion to the whole circumference, so that although there is still a somewhat greater distance here between the two scapulæ placed on either side of it, than between the other scapulæ, yet the irregularity is not such as to occasion any material inconvenience or interruption of symmetry. The

ACTINOCRINITES 30. DACTYLUS. PL IV.



Miller del.



ACTIVITIES OF DACTYLUS

1. The first activity of the dactylus is the

second activity of the dactylus is the

third activity of the dactylus is the

fourth activity of the dactylus is the

fifth activity of the dactylus is the

sixth activity of the dactylus is the

seventh activity of the dactylus is the

eighth activity of the dactylus is the

ninth activity of the dactylus is the

tenth activity of the dactylus is the

eleventh activity of the dactylus is the

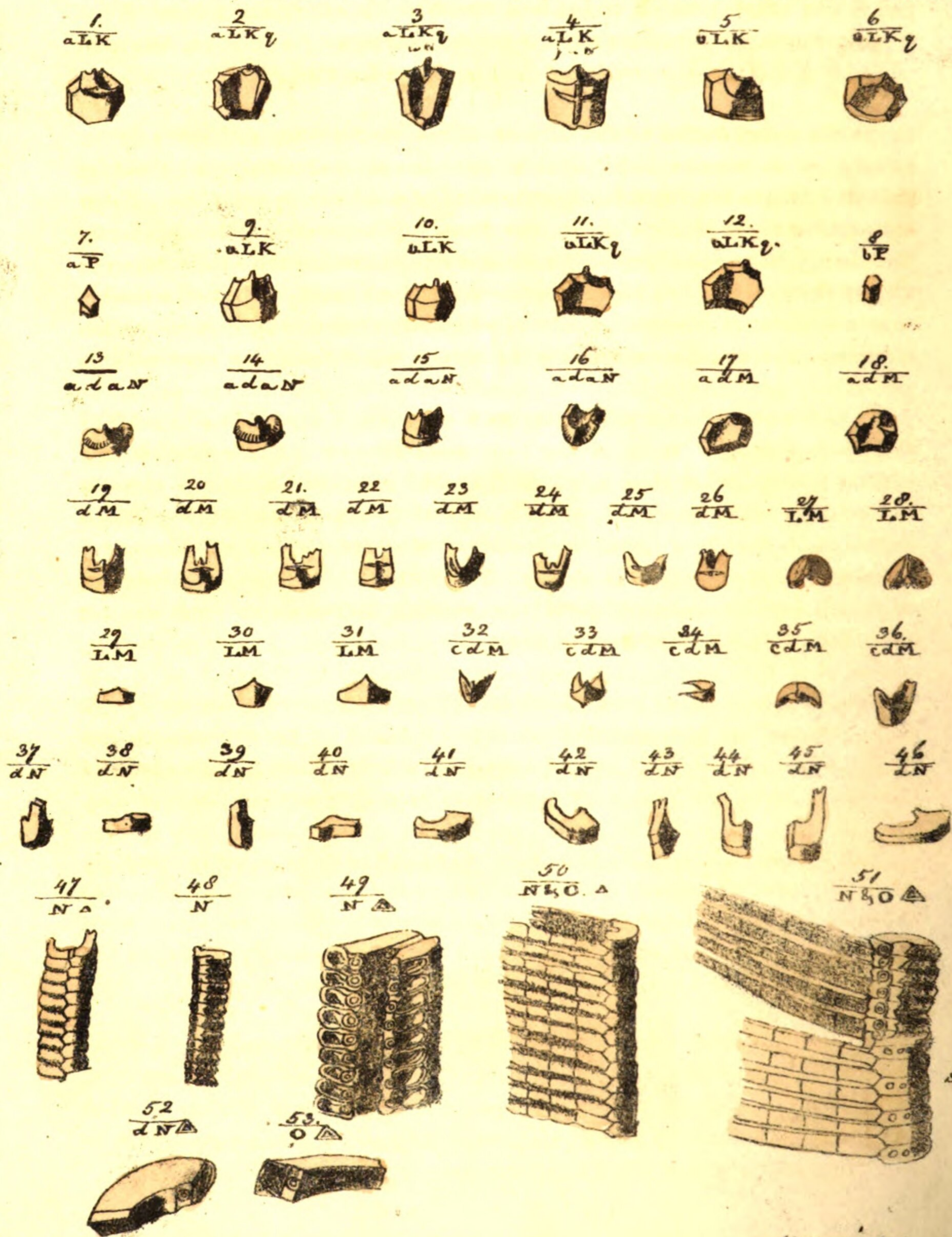
twelfth activity of the dactylus is the

thirteenth activity of the dactylus is the

fourteenth activity of the dactylus is the

fifteenth activity of the dactylus is the

ACTINOCRINITES 30 DACTYLUS. PL. V



Miller. Del.

use of this interval, which, as has been observed, has something similar to it in *Poteriocrinites* and *Cyathocrinites*, is yet unexplained. I have sometimes conjectured that it may have included the opening of the oviduct.

To the upper angles of the scapulæ adhere two oblong cuneiform joints, forming as it were a short double arm, having sometimes the point of their inner angle truncated for the admission of a minute square plate. From the superior angle of each of the cuneiform joints proceed (Pl. I. fig. 1.) on the sides approaching a series of joints forming the hand, and on the outer sides a finger composed of two slightly horse-shoe shaped joints, on which a double series of joints are arranged, bevelling off and dovetailed at their inner margin into each other, and thus resembling the finger joints of *Encrinites moniliformis*.

Thus the series of joints forming the HAND, (Pl. v. fig. 17. to 36.) proceed each from the inner angle of the two cuneiform arm joints affixed to the scapulæ; they vary in their form, the first joint being simple, convex towards the middle of its outer margin, slightly excavated above, to admit the next or second joint, which by the irregular form of its upper and lower edges resembles a double wedge, (fig. 33. to 35.) Above this two half joints are inserted, on which another cuneiform joint rests, sending off two fingers each like the first, formed of a double series of joints.

The first joints of the hand adhere laterally at their approaching surfaces to each other, and are here somewhat truncated to admit the minute square plates mentioned before; at their outer lateral surface they adhere firmly to the first joint of the first finger, which again connects laterally with the pectoral plates.

The FINGERS (Pl. v. fig. 37. to 51.) are formed of two series of joints, adhering where they dovetail laterally into each other by a muscular integument only: this accounts for not unfrequently meeting specimens where their series have separated in this part for a considerable length, and thereby neatly displayed the interior formation and insertion of the first tentacular joint.

PECTORAL PLATES. (Pl. IV. fig. 27. to 29.) Between the scapulæ are inserted several series of small hexagonal, heptagonal, and octagonal plates, connected with the integument covering the abdominal cavity, so often already alluded to in other specimens. These I have named the pectoral plates; they seem to be capable only of a very slight muscular contraction.

A small CLAVICULAR JOINT inserted between the two hands proceeding from one scapula, separates the integument and vessels under it in their progress upwards. (PL. II. fig. 5.)

CAPITAL PLATES.—(PL. IV. fig. 30. to 39.)—The plates forming the upper part of the integument over the abdominal cavity, I have named capital plates; they have like the pectoral plates different angles, but are covered by a thicker muscle, which is connected (although only slightly so, as appears from the pectoral plates not exhibiting those folds which result from strong muscular action) with those proceeding from the pelvis over the first costals, and laterally extending upwards over the intercostals and pectorals. It receives a new impulse from a sphincter-like muscle placed in the centre, which is capable of forcing up the margin of the mouth into an elongated and protruding proboscis, and at the same time contracting the area between the arms, and thereby enabled to pull these up, and bring the hands and fingers together in a close fasciculus. Meanwhile the muscle or portion of muscle covering each capital plate, is also able by its contraction to draw up in the centre, and thereby to form a more or less elongated tubercle, whose office it probably is to push on the food to the mouth, so that the whole integument thus assumes an echinated appearance. When the contractile force is most strongly exhibited, the proboscis also becomes studded with similar tubercles (PL. II. fig. 1. and 2.) but otherwise those tubercles are exhibited only on the capital plates more remote from the centre, those near the proboscis remaining smooth. (PL. II. fig. 6. and 7.) On the relaxation of the muscles these tubercles disappear—the proboscis gradually subsides—the space between the arms widen—and the fingers are permitted to expand. Specimens in every state of contraction occur in a fossil state, and most distinctly prove that the markings and appearances described, can be ascribed only to muscular action.

ACTINOCRINITES.

DACTYLUS

PL VI



Miller del.

THE UNIVERSITY OF CHICAGO

PHYSICS DEPARTMENT



BY J. J. THOMSON

ACTINÓCRINITES POLYDACTYLUS. PL. III

$\frac{1}{A}$



$\frac{2}{A}$



Miller del.

II. SPECIES. ACTINOCRINITES POLYDACTYLUS.

MANY-FINGERED, RADIATED, LILY-SHAPED ANIMAL.

Specific Character.

A Crinoidal animal, with a round column formed of many joints, surmounted by a pelvis of three plates, having affixed at their upper edge five hexagonal, and one pentagonal costal plate, on which another row of second costals and intercostal plates adhere. From the scapulæ which rest on the second costals, proceed five arms, each having two hands terminating in four or five fingers. Alimentary canal round. Base provided with elongated fibres.

Reference and Synonymes.

Luidii Ichnographia, tab. 22. fig. 4. (bad) and centre figure, p. 130.

LHWYD'S Letter to Dr. LISTER, in Philosophical Transact. No. 243. fig. 16.

Locality.

Mountain Limestone of the Mendip Hills, and Caldy Island.

Description.

It is a smaller and neater species (PL. I. fig. 1.) than *Antinocrinites triacantadactylus*.

Its column and auxiliary side-arms however resemble it, and display the same structure as has been noticed before.

The Plates at the summit of the column including the viscera, are similarly formed and arranged, but being more muscular offer a few rather different

characters. A simple contraction produces on every plate a nearly pointed star-like figure, each ray being directed towards the sides. A partial contraction extends the points of the rays, and a very powerful one forms a continuation of the rays of the star on one plate, extending with an equal thickness to the adjoining plate. It is this degree of contraction which permits our tracing the direction which the muscles pursue in acting on the arms and capital plates, as may be fully seen in a fine specimen in my collection. (PL. II. fig. 1.) The divided action from the three adhering joints of the pelvis produces two folds, directed to the centre of the first costal plates, (resting upon the lines of their sutures); here it unites and proceeds over the second costal to the centre of the scapula, where the muscle divides and attaches to the first joint of each hand. Another fold extends laterally on each side from the centre of the first costals across the intercostals near it, to the first fingers of the opposite arms, each again dividing at the second intercostals, and sending branches to the pectoral plates. Other rays decisively point out lateral action. Another specimen in my collection, shows the ridges produced by contraction slightly waved, (PL. II. fig. 3.) whilst a third specimen (PL. II. fig. 4.) exhibits two or three ridges, according as the costals traversed by them are inserted over the suture of the pelvis, or over the middle of its plates, sending double folds to each of the two lateral angles, and producing a corrugation in the centre of the costals.

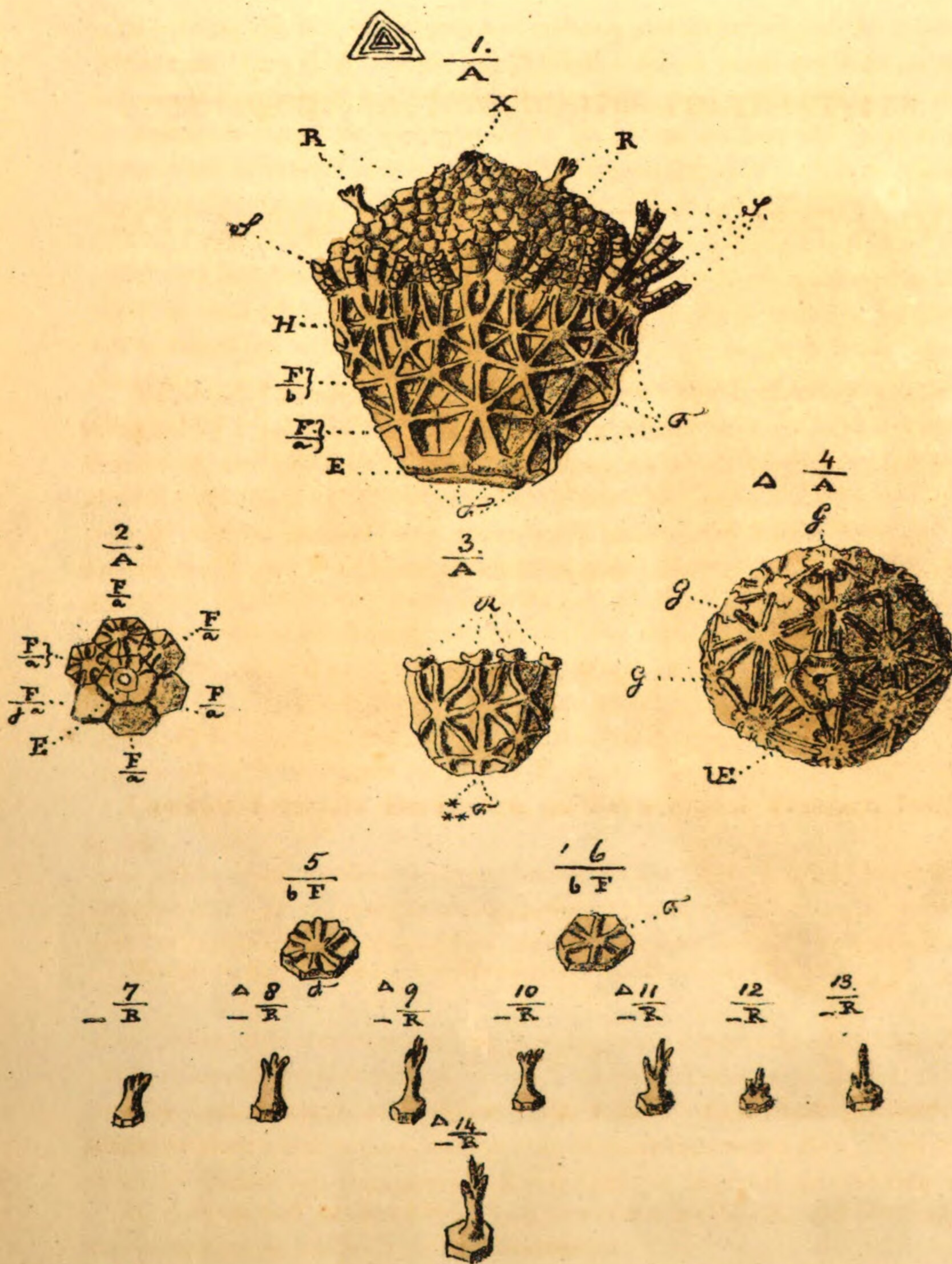
The **PECTORAL PLATES** (PL. II, fig. 7. to 14.) do not contract into a simple tubercle, but form an elongation dividing at its summit into several points.

The first **FINGER** sets off from the outside of the cuneiform joints of the arm, and the continuation of the hands consists of two or three series, each containing two common and one cuneiform joint, and terminating in three or four fingers.

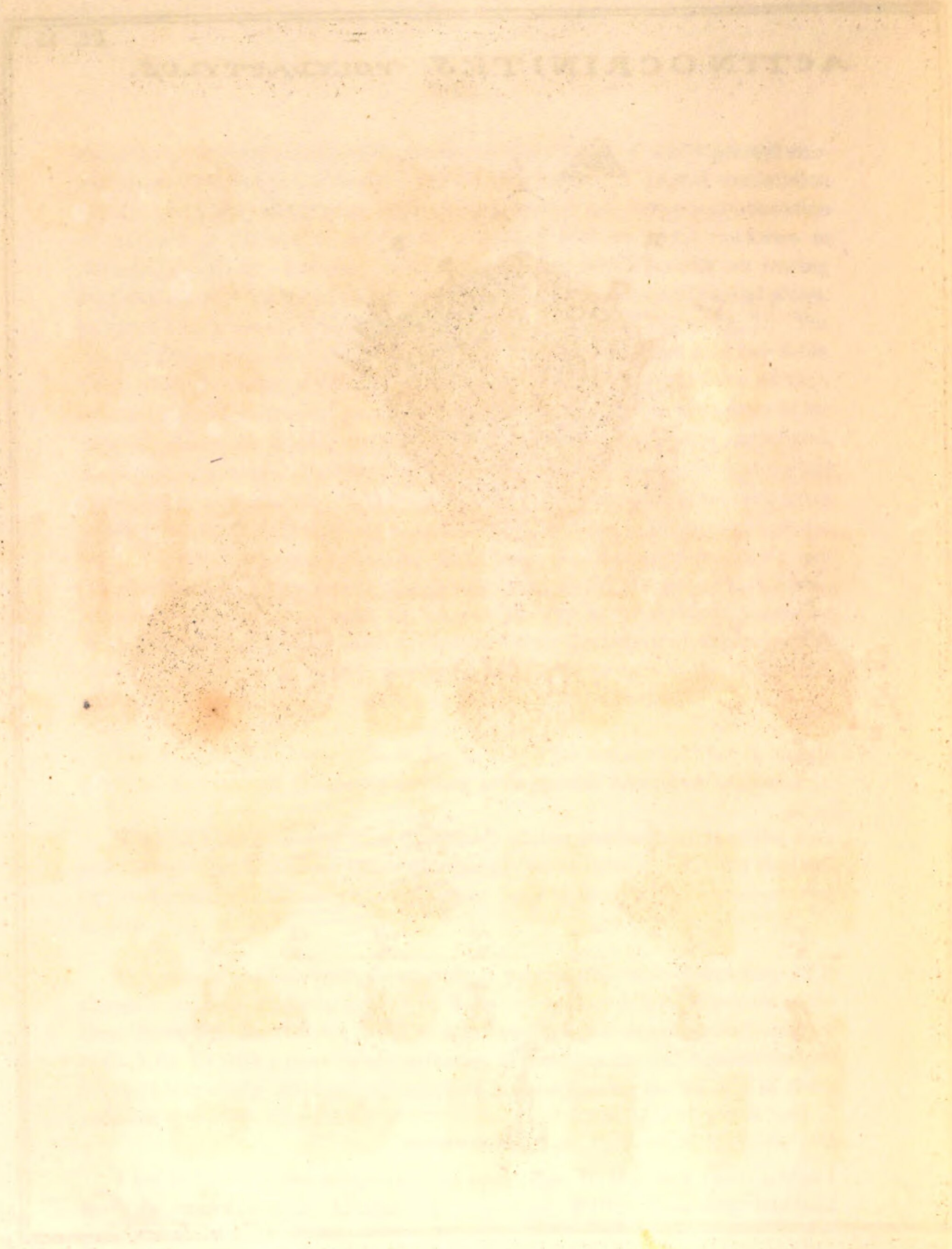
The proboscis-like mouth, is capable of very considerable elongation, as is shown in the fine specimen figured by **LHWYD**: by the obliging kindness of the **Rev. Professor BUCKLAND**, I have been enabled to examine and refigure it (PL. I. fig. 2.) with a more careful attention to those anatomical details to which I have particularly directed my inquiries in investigating the history of these animals.

I am indebted to the polite attention of the **Rev. R. HALIFAX**, (with whom I made an excursion to the **Mitcheldean Limestone Basin**) for several detached

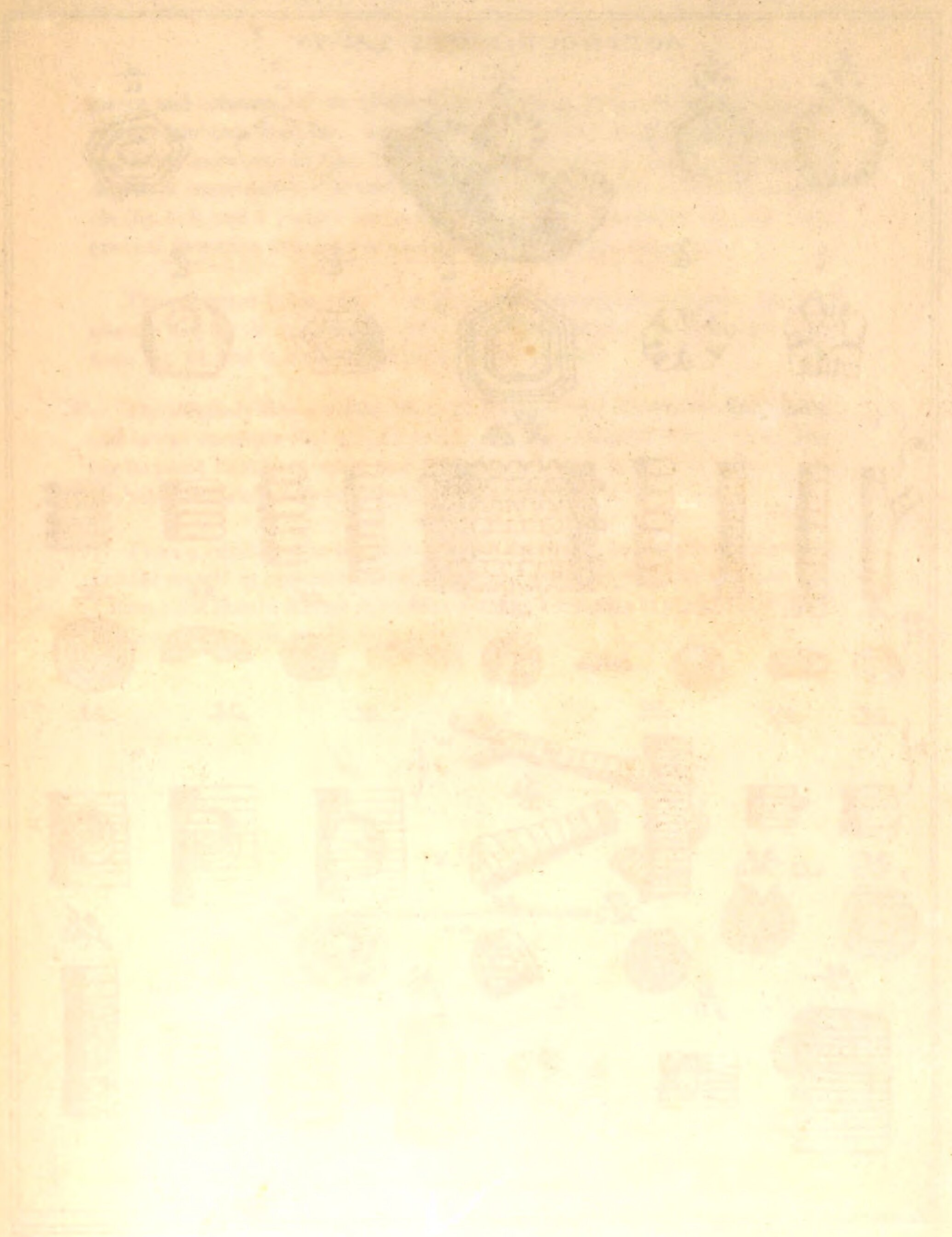
ACTINOCRINITES POLYDACTYLUS.



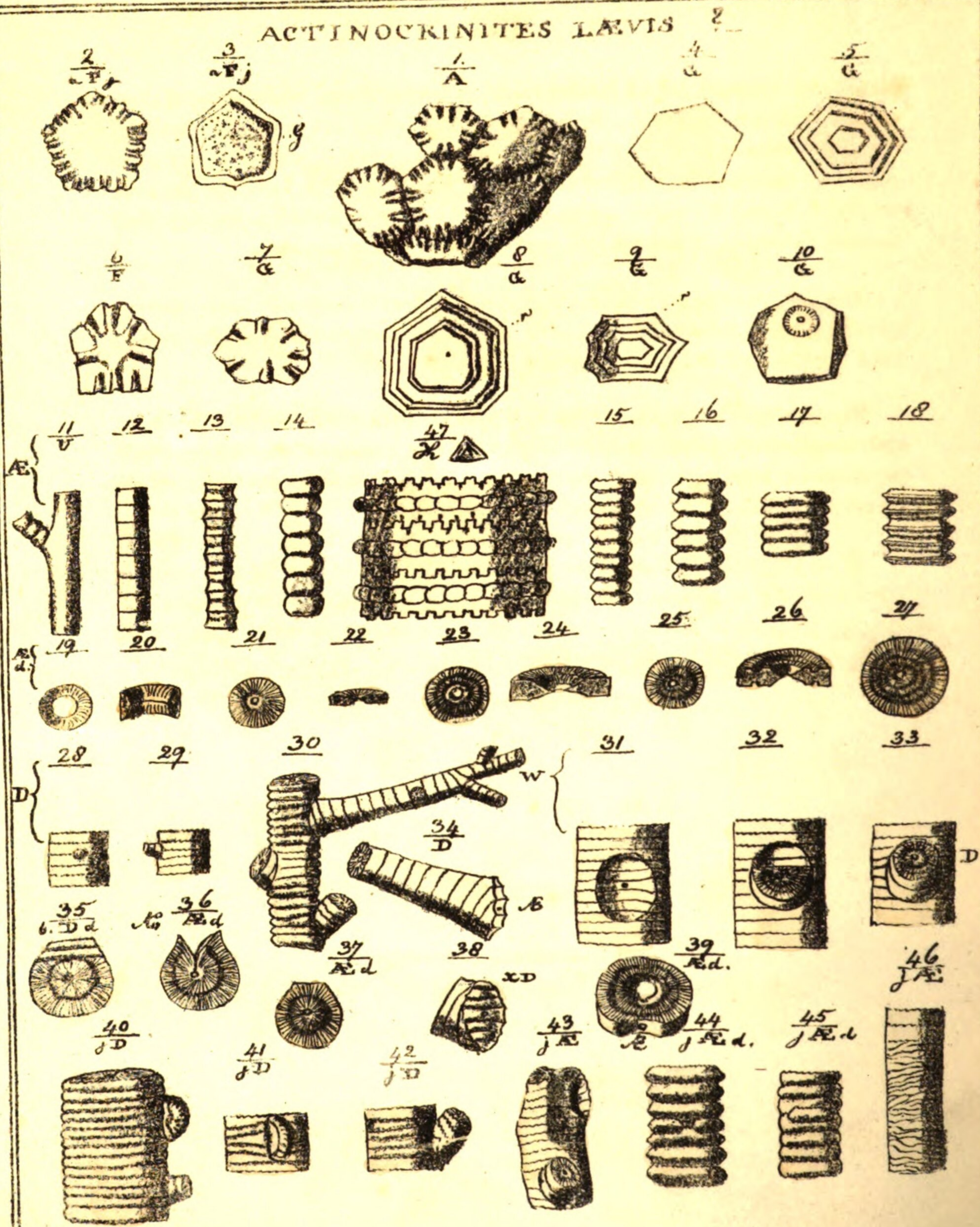
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ACTINOCRINITES LAEVIS



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plates and columns, of an actinocrinite occurring there, resembling *Actinocrinites triaconta dactylus*. Its plates (fig. 1. to 10.) are, however, generally speaking, more smooth than those of the former species, yet showing a great degree of muscularity. In many instances they appear to have lost the muscle (fig. 5. 8. and 9.) which covered them, and then beautifully display their gradual formation in laminae successively applied to each other.

The columnar joints (fig. 11. to 27. and 47.) are remarkably neat, but frequently display the results of injury and partial repair, in interposed portions (fig. 44. and 45.) and irregular wrinkles, (fig. 46.)

The auxiliary side arms (fig. 28. to 38.) branch from the column irregularly, and in one specimen (fig. 40. and 41.) a side arm comes off with a curve, having its point bent back upon and adhering to the column; this position was probably occasioned by an irregularity in growth.

From a reluctance to increase without necessity, the number of species, I confine myself at present to merely mentioning the singularities of these specimens; but should further researches prove it a truly distinct species, I think *Actinocrinites lævis* would form a good name.

VIII. GENUS. RHODOCRINITES.

ROSE-LIKE, LILY-SHAPED ANIMAL.

Generic Character.

A Crinoidal animal, with a round and sometimes slightly pentagonal column, formed of numerous joints perforated by a pentapetalous alimentary canal. The pelvis formed of three pieces supporting five square plates, in the spaces of whose lateral bevelled angles five heptagonal first costals are inserted. From the scapulæ proceeds an arm supporting two hands.

Observation.

The name of this Genus is derived from the Greek word $\rho\omicron\delta\omicron\varsigma$, a rose, and applied from the rose-like figure of the alimentary canal.

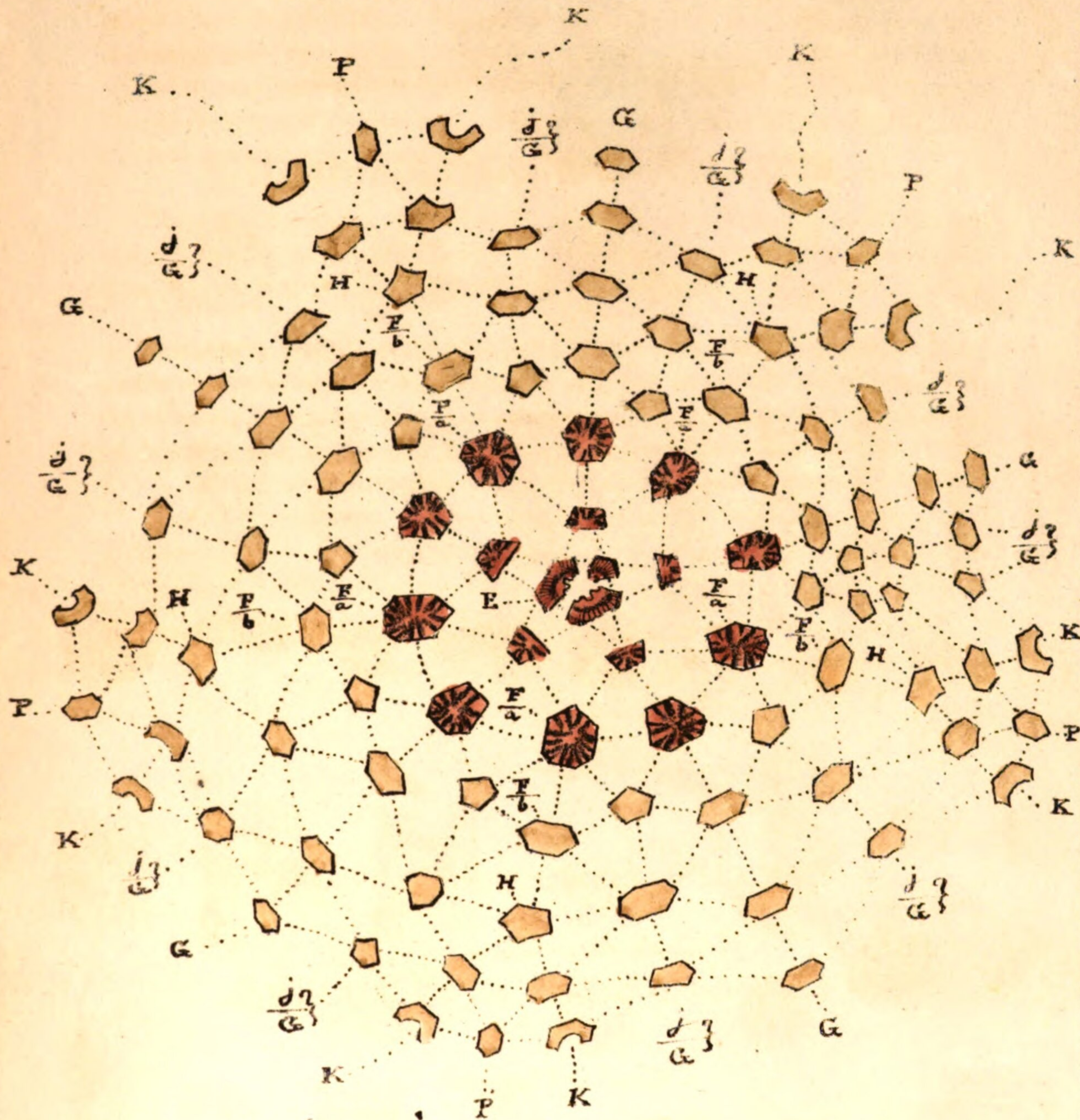
I. SPECIES. RHODOCRINITES VERUS.

TRUE ROSE-LIKE, LILY-SHAPED ANIMAL.

Generic Character.

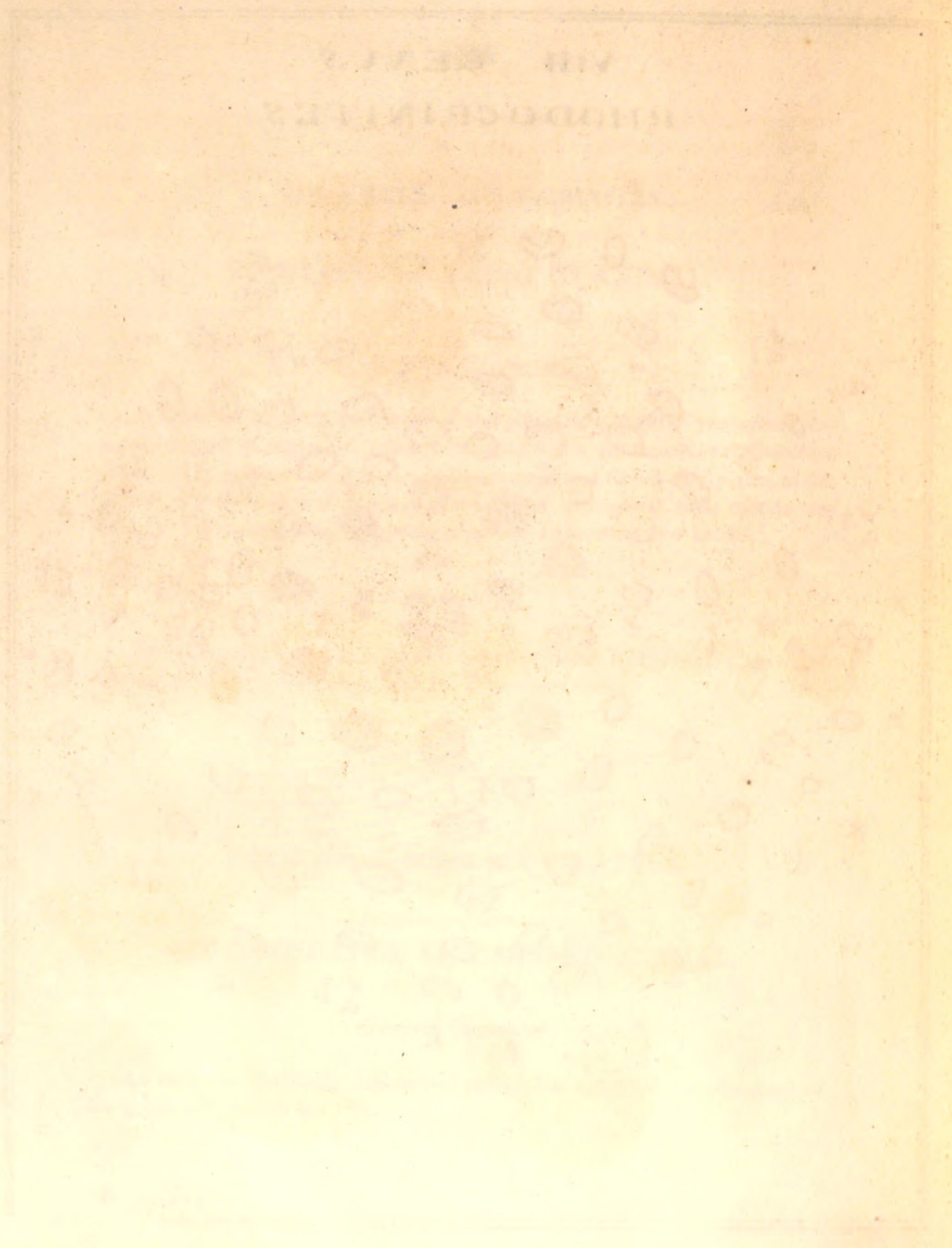
As only one decidedly ascertained species has occurred, the character of the genus will identify it.

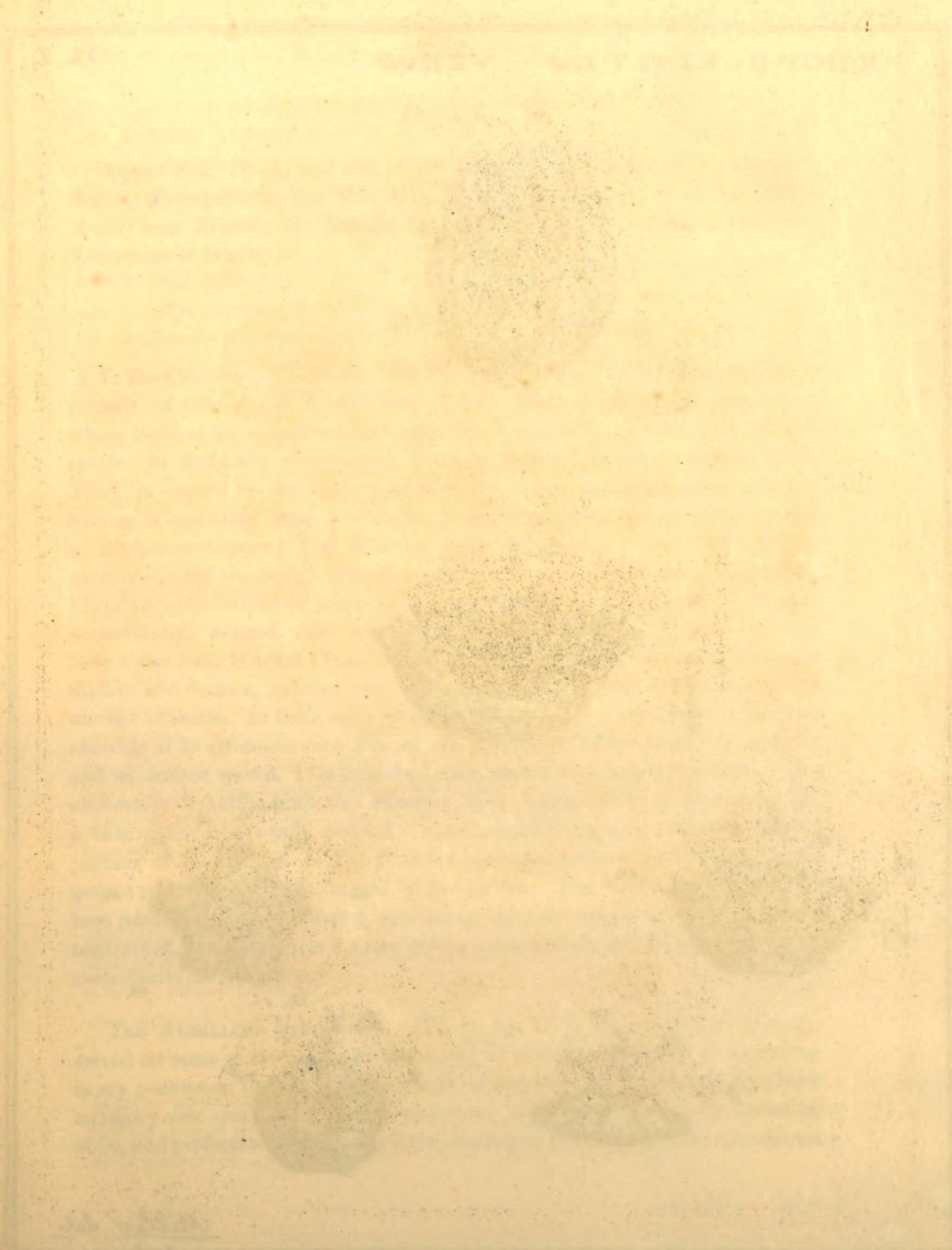
VIII. GENUS RHODOCRINITES



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THE
HINDOOSTAN





THE HISTORY OF THE

REIGN OF

CHARLES THE FIRST

BY

JOHN BURNET

OF THE UNIVERSITY OF OXFORD

IN TWO VOLUMES

LONDON

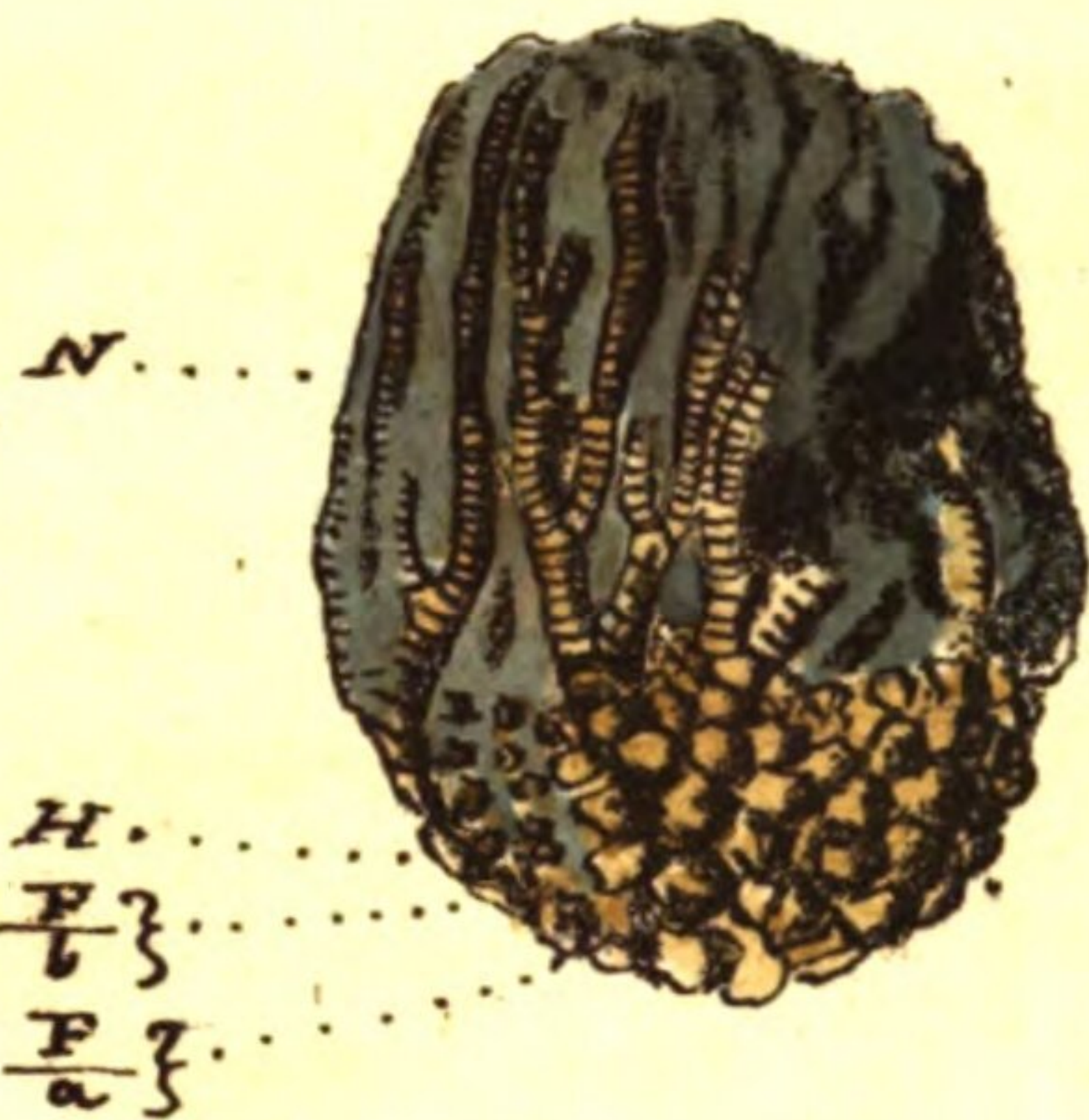
Printed by J. Streater, at the Sign of the Gun, in St. Dunstons Church-yard

1679

RHODOCKINITES VERUS

PL. I.

$\frac{1}{A}$



$\Delta \frac{2}{A} u.$



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Locality.

Upper Bed, No. 1, and one of the lower Beds, No. 15, of Dr. BRIGHT'S Series, distinguishing the Mountain Limestone formation along the River Avon, near Bristol; the Mendip Hills; Mitchel Dean; and the transition Limestone at Dudley.

Description.

In the COLUMNS (PL. II. fig. 1. to 22.) which I consider as belonging to the animals of this genus, I have noticed two different modes of organization, which inclines me to suspect that although I am only able to treat of one species as decidedly ascertained, yet two distinct species may really exist. Thus, in regard to the surface of adhesion, some columnar joints display numerous radiating striæ proceeding immediately from the alimentary canal to the circumference; (fig. 6. to 10.) other joints (fig. 1. to 5.) have only a narrow striated rim with a smooth central area; and again some columns (fig. 11. to 15.) are formed of joints of uniform thickness, from some of which, occasionally, several side arms proceed; whilst other columns particularly those from Mitchel Dean, (fig. 17. to 22.) are formed of joints alternately thicker and thinner, smaller and larger, much contracted at their margin of mutual adhesion. In these every second or fourth joint is considerably thicker, showing at its circumference five or six tubercles, which render it angular and its surface waved, to which the joints above and below conform. The alimentary canal in both the columns thus distinguished is pentapetalous, a form which I have only noticed in *Cyathocrinites rugosus*, and in the upper portion of the column of *Platycrinites quinquangularis*, and some of those genera where the pelvis is formed of five pieces. The form of this pentapetalous passage varies in different specimens from the angles being more or less contracted, which renders it more or less conspicuous, and thereby proves the muscularity in this place.

The AUXILIARY SIDE ARMS. (PL. II. fig. 11. to 15.) The tubercles observed on some of the columnar joints may be traced on the suite of specimens in my possession through various stages of increase, till at length they form auxiliary side arms composed of numerous joints, articulating by radiating striæ, and perforated in the centre by a nourishing vessel which near the column

is of an elliptical form, having the sides pressed in, but becomes round as the arm elongates. The growth and insertion of the auxiliary side arms in the column, is conformable to what was observed when speaking of *Actinocrinites triaconta dactylus*. One specimen (fig. 8. and 9.) in my possession shows the conical insertion of the first auxiliary arm joint very distinctly.

The pelvis (PL. I. fig. 5. and 6.) is saucer-shaped, composed of three plates, having in the depressed centre where they articulate to the column, a pentapetalous opening forming the entrance to the alimentary canal. At the upper edge they are excavated, forming five slightly concave spaces, showing a finely striated rim at the exterior margin for the firmer articulation of five intercostal plates.

On account of the first INTERCOSTAL PLATES, which are of an oblong square form, inclining outwards, an angle is formed between each two, into which a first costal plate is inserted.

The five FIRST COSTAL PLATES are heptagonal and pointed, supporting each a hexagonal second costal plate, and a scapula.

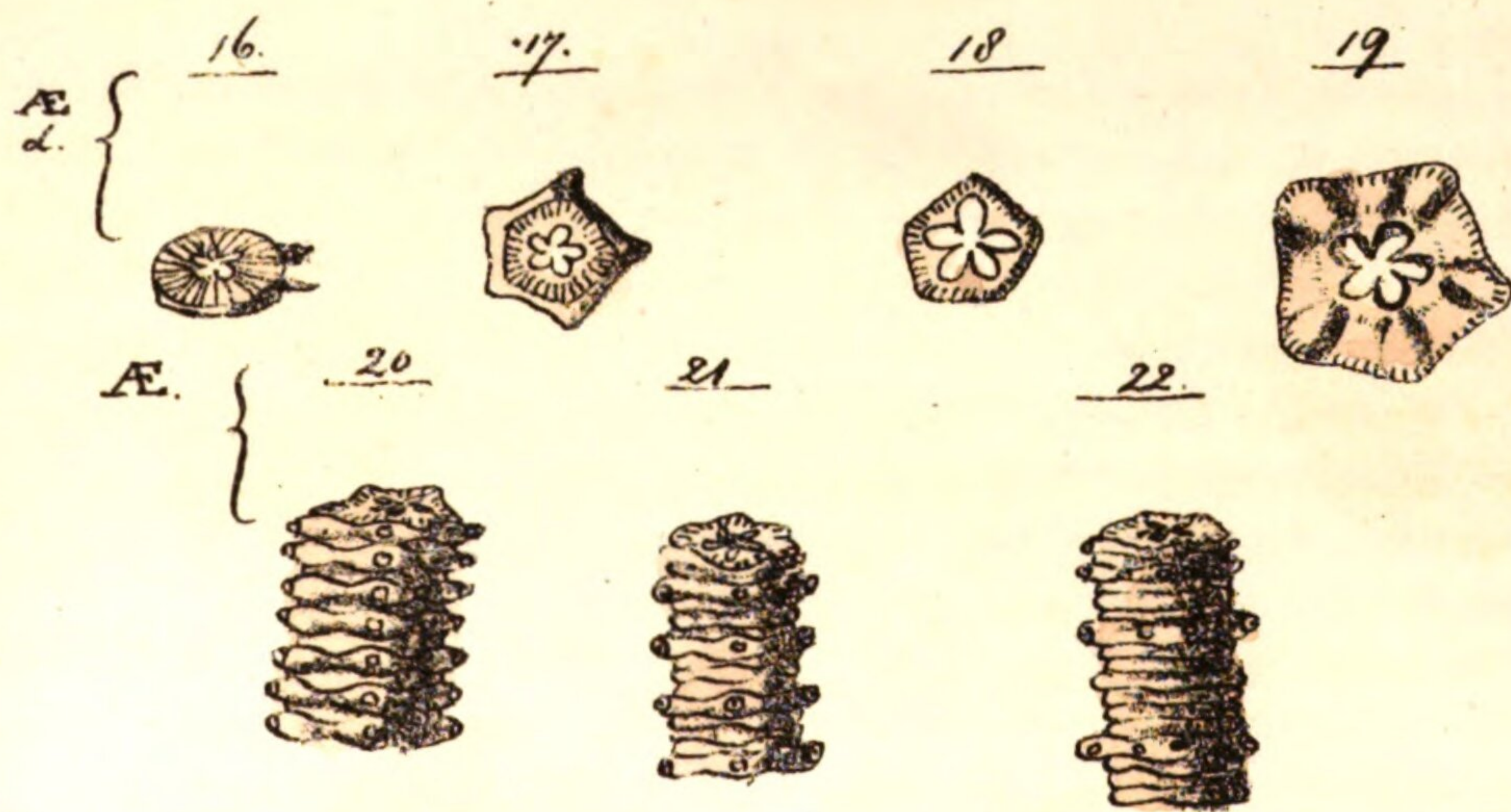
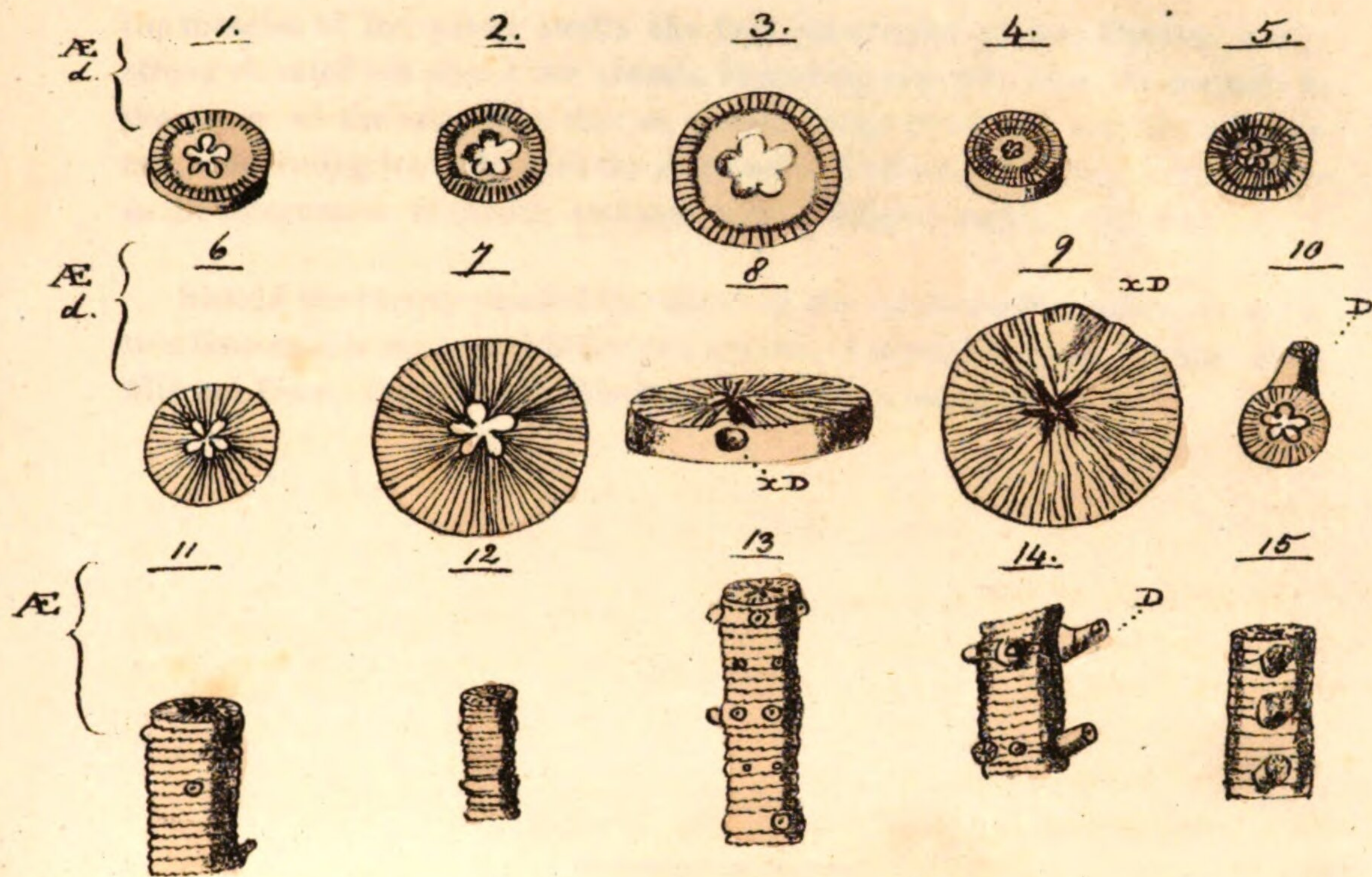
On the first intercostal plates (PL. I. fig. 2.) rest a series of several hexagonal oblong intercostal plates, gradually decreasing in size upwards, having in the angles between them and the costals a few irregular intercostals, placed in a double series on the sides where (as in the former species) the structure of the animal occasions that wider interval between two of the arms than between the rest, for the purpose of which we are yet unable to account. The intercostals and irregular intercostals mix above with the mass of minute plates belonging to the integument over the abdominal cavity.

The ARMS and FINGERS. From each of the scapulæ proceed two first arm joints, and from these a second, between whose inner angles a clavicular plate is inserted. C. STOKES, Esq. sent me a drawing of the superior portion of this animal found at Dudley (PL. I. fig. 1.) which shows that the arms support two hands each provided with several fingers.

A radiating contraction (PL. I. fig. 2.) is capable of being formed by muscular action on each of the costal and intercostal plates, similar to that noticed in *Actinocrinites Polydactylus*. A powerful contraction (fig. 3.) arising from

RHODOCRINITES VERUS

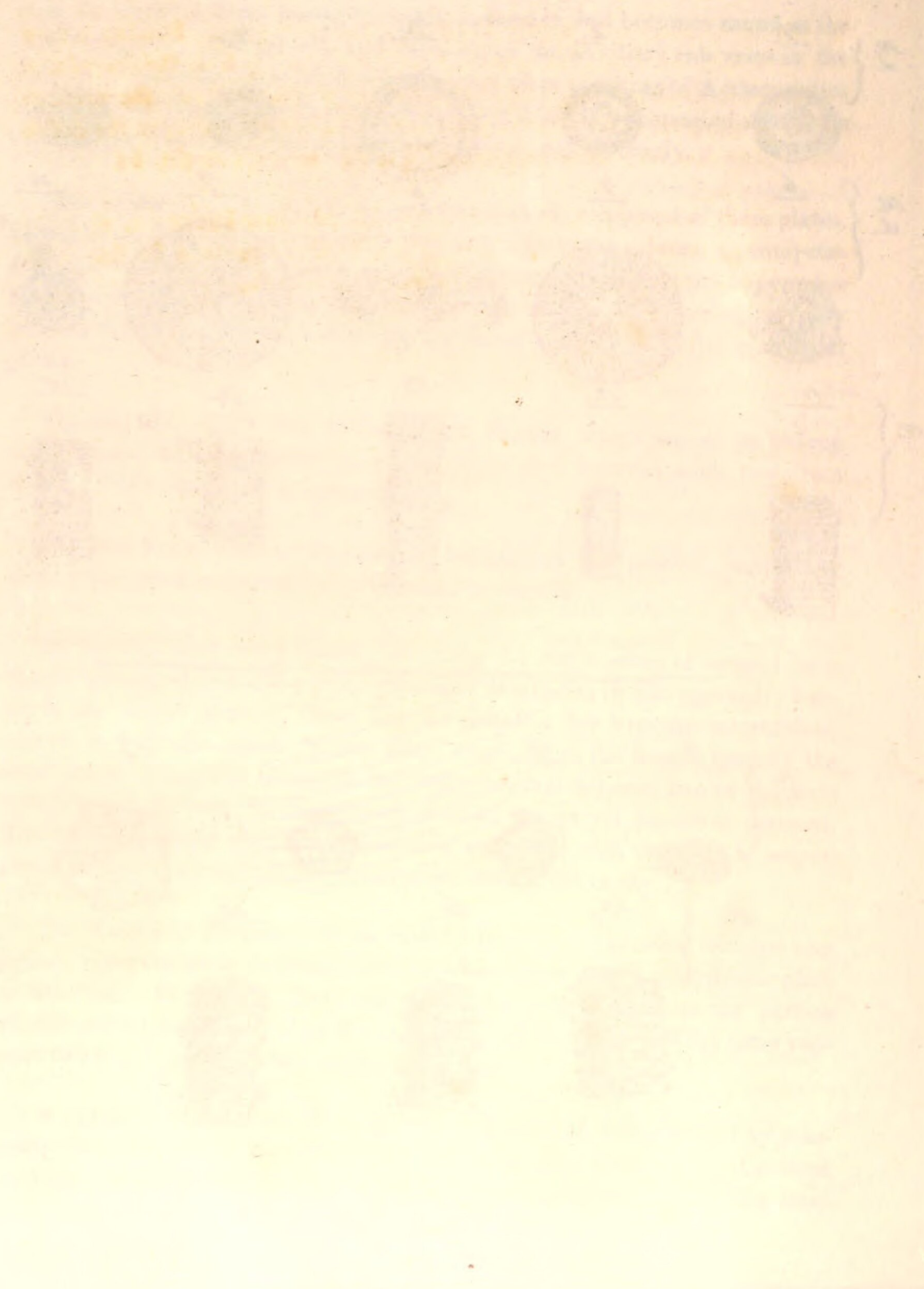
PL. II.



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RHODOCHRYNITES



the muscles of the pelvis swells the first intercostal plates, forming a very strong elevated rib across the costals, branching laterally from the scapulæ to the arms, at the same time that an elevated ridge is formed over the intercostals, connecting laterally with the ridge noticed before, extending to the orifice in the integument or mouth and rendering it subpentangular, (fig. 4.)

Should the variety pointed out above in the columnar formation, at a future time enable me to establish two species, I should propose for that from Mitchel Dean, the name of *Rhodocrinites quinquangularis*.

COADUNATA?

Character of the Division.

THE joints of the pelvis ankylose to the first columnar joint.

Observation.

I have been induced to constitute this fourth division from the occurrence of a single species, in which the pieces composing the bulbous body of the animal, instead of being connected by articulations or sutures as in the preceding division, are united together by a solid and continuous ankylosis; it will be seen, however, that some doubts may be reasonably entertained, whether the circumstances described may not arise from the imperfect development of the separate pieces, in that cartilaginous state which characterises the early stage of growth in these animals; should this prove to be the case, the genus which I have formed for the reception of the only species known to me, and which forms the subject of the following article, would certainly fall under the first division, and perhaps (as will hereafter be noticed) may be only the younger state of a species belonging to the Genus *Eacrinus*; on these accounts I have placed this division, which can only be considered as of a temporary nature, at the end of the series, and marked it with a note of interrogation.

IV. Division.

COADUNATA ?

Character of the Division.

THE joints of the pelvis anchylose to the first columnar joint.

Observation.

I have been induced to constitute this fourth division from the occurrence of a single species, in which the pieces composing the bulbous body of the animal, instead of being connected by articulations or sutures as in the preceding division, are united together by a solid and continuous anchylosis; it will be seen, however, that some doubts may be reasonably entertained, whether the circumstances described may not arise from the imperfect development of the separate pieces, in that cartilaginous state which characterises the early stage of growth in these animals; should this prove to be the case, the genus which I have formed for the reception of the only species known to me, and which forms the subject of the following article, would certainly fall under the first division, and perhaps (as will hereafter be noticed) may be only the younger state of a species belonging to the Genus *Encrinus*; on these accounts I have placed this division, which can only be considered as of a temporary nature, at the end of the series, and marked it with a note of interrogation.

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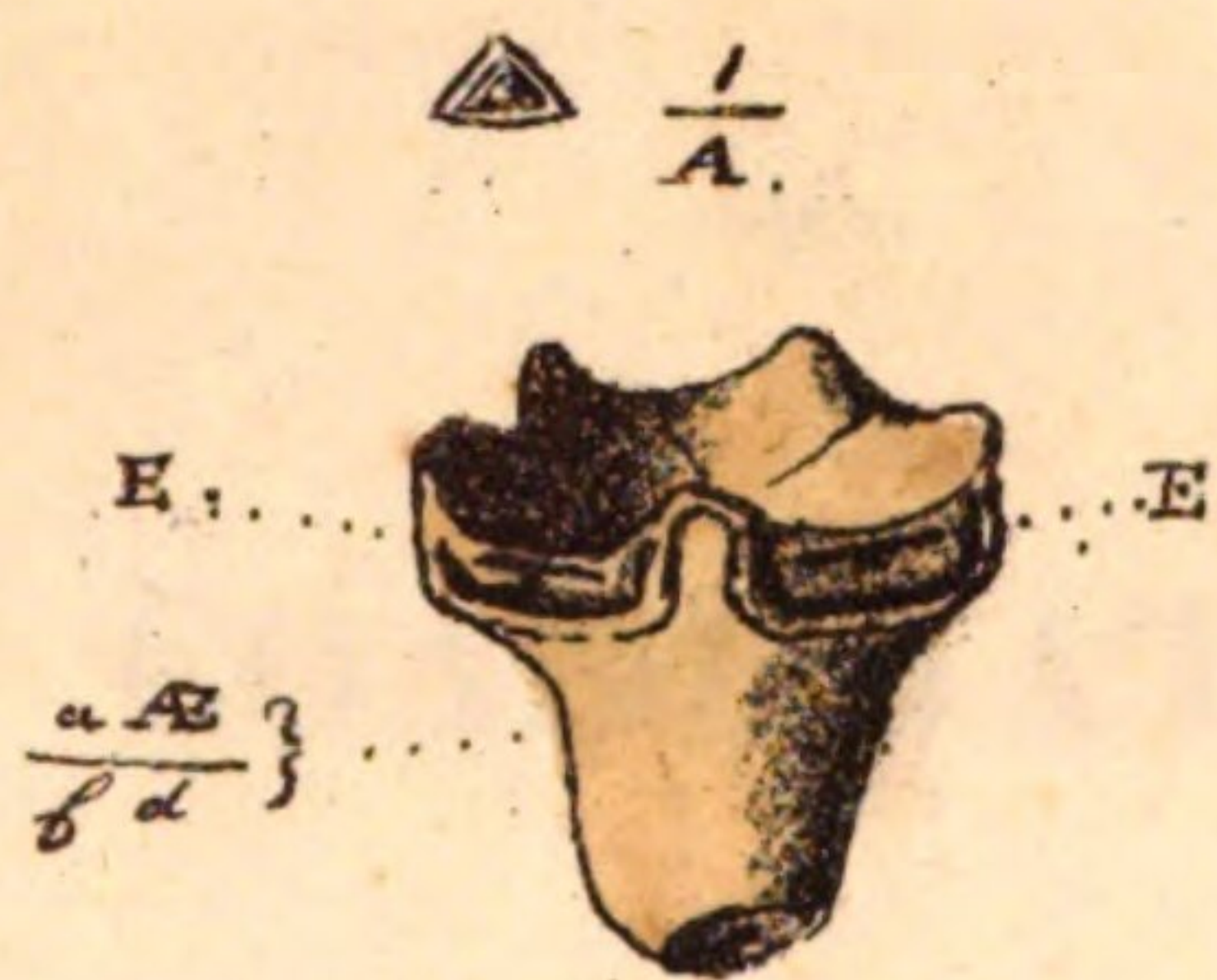
TO BE KEPT IN THE

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IX GENUS

EUGENIACRINITES

E: QUINQUANGULARIS.



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IX. GENUS. EUGENIACRINITES?

CLOVE-LIKE, LILY-SHAPED ANIMAL?

Generic Character.

Superior Columnar joint, subpentangular enlarging above, having the five plates of the pelvis adhering to it by a solid anchylosis.

Base, Column, Joints resting on the pelvis, and fingers unknown.

I. SPECIES. EUGENIACRINITES QUINQUANGULARIS?

CLOVE-LIKE, LILY-SHAPED ANIMAL, WITH FIVE-ROUNDED ANGLES?

Specific Character.

As only one species is known, the character of the genus identifies it.

Reference and Synonymes.

Clove Encrinite, PARKINSON, Vol. II. t. XIII. fig. 70.

Caryophyllus Lapideus.

Caryophyllite, KNORR, t. XXXVI. fig. 29.

Locality.

Switzerland, at Mount Randen (KNORR); also in the Canton Zurich and Schafhausen.

Description.

The first appearance of the enlarged columnar joint with its attached pelvis, much resembles the unripe fruit of the clove-tree, *Eugenia Caryophyllata*, (formerly *Caryophyllus aromatica*) so well known among common culinary spices. From hence it has taken its name, having attracted from this circumstance and its frequent occurrence, particularly at Mount Randen, the attention of the earlier naturalist who considered it as a petrified fruit, until LLWYD gave the first hint that it belonged to the crinoidal family.

It is unfortunate that the other portions of this animal have not as yet been identified, and I have further to regret that, from my want of opportunity and connection in Switzerland, I have been hitherto unable to procure more illustrative specimens. I hope however at some future time to enter further in its investigation, under more favourable circumstances.

The first COLUMNAR JOINT is slightly pentangular, where its inferior surface covered with radiating striæ has evidently articulated with the joint next below it, and displays in the centre the perforation of the alimentary canal. Upwards it enlarges, showing at the summit a pentangular circumference, arising from the columnar joint accommodating itself to the frequent pressure of the lower portion of the costal joints, which as in the Pentacrinite must have depended over it. This joint must have originally possessed a yielding and cartilaginous texture and consistency, which is indicated in the specimens by a slight curve, evidently occasioned by the pressure resulting from a lateral inclination of the superior part of the animal. Its upper surface is slightly convex, but it again slopes downwards towards the centre, thus becoming concave where the entrance of the alimentary canal is situated.

The PELVIS. An anchylosis firmly connects with the first joint of the column the five joints of the pelvis, which are of a depressed rhombic figure, and arranged on it in a similar manner to those of *Encrinus moniliformis*. Each of

the joints is at the exterior circumference angularly truncated, so that a pentagonal circumference is formed, the sides of which are slightly excavated. On each of the sides of the angle arising from the truncation of the joints of the pelvis, at the exterior surface, a transverse ridge with a central perforation may be traced, which unites with that from the neighbouring joint, and thus offers a firm articulation in each of the five excavated spaces for one of the first costal joints, which gain further support by resting against the column where they occasion the impression noticed before.

I have no hesitation in saying that this animal when perfect must have borne considerable resemblance to *Encrinites moniliformis*; yet it appears to be sufficiently distinguished from that genus by the enlarged first columnar joint, and the firm adhesion and growing together of the pelvis with it. It is this latter circumstance which at once accounts for the columnar joint never occurring without the pelvis.

I cannot, however, omit to suggest a conjecture concerning these specimens, which has occurred to me as probable, with regard to the anchylosing of the pelvis to the column. The Crinoidea in an early stage of growth, as I have shown when speaking of *Pentacrinus caput medusæ*, do not display the different joints of which they are composed in so distinct and well marked a manner as on mature age; the calcareous matter forming their nucleus has not yet been secreted in sufficient quantity, and remains so involved with the membranous parts, as often to render it impossible to determine the line of separation between one joint and the other. Now the specimens of *EUGENIA CRINITES* *quinquangularis*, occur only of a very small size; and I have before alluded to the marks of original cartilaginous consistency exhibited by one in my possession. Should then these remains be those of young animals, in which an insufficient calcareous secretion has not as yet distinctly separated the plates, they might very possibly assume the regular character of the genus *Encrinites* in a more advanced stage of their growth. Of course in this case it would become necessary to suppress this genus, and incorporate it in that indicated.

APPENDIX.

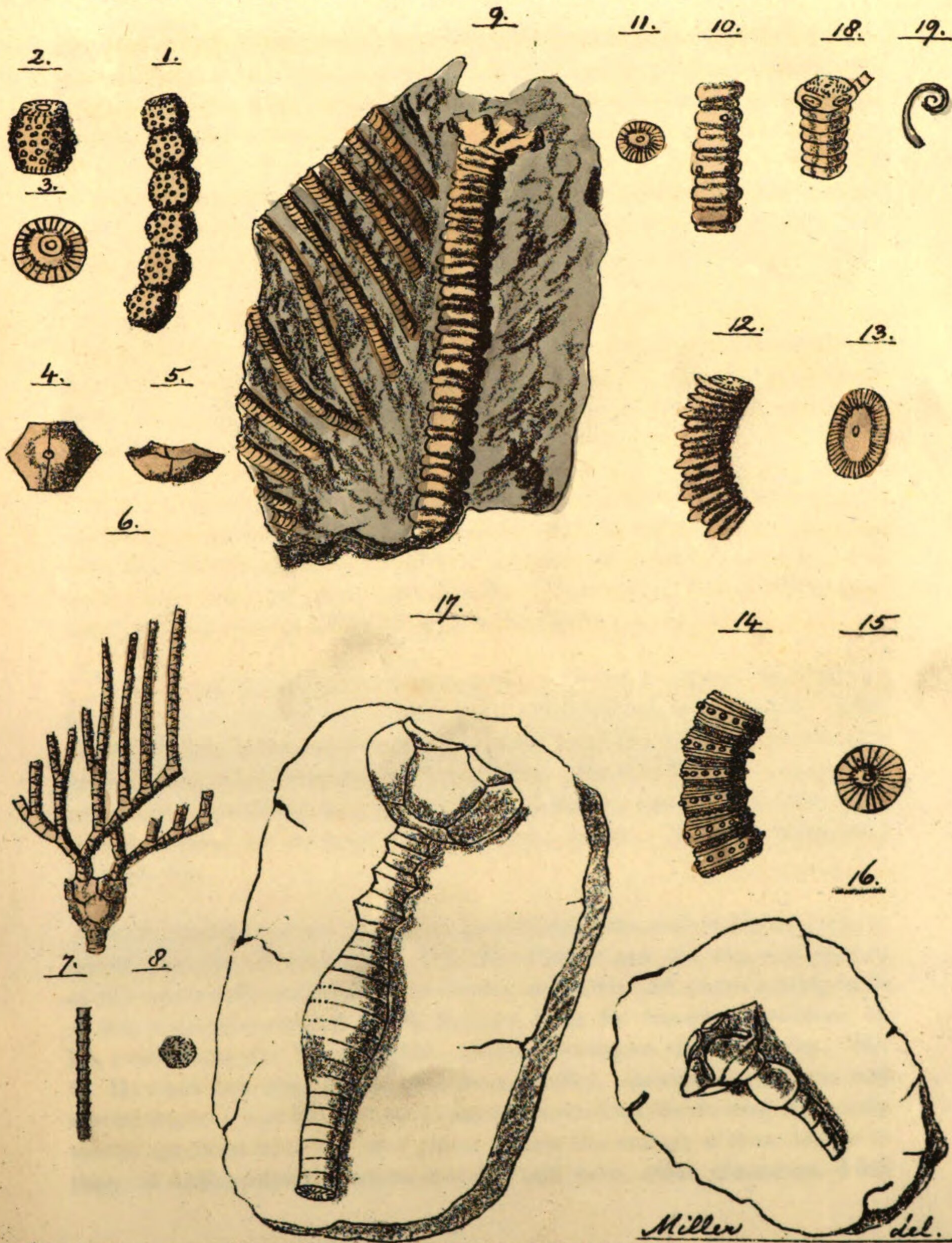
IN the course of my observations on the Crinoidal remains, several have occurred to me which, although I as yet possess only fragments of them, I do not wish to pass over entirely without notice.

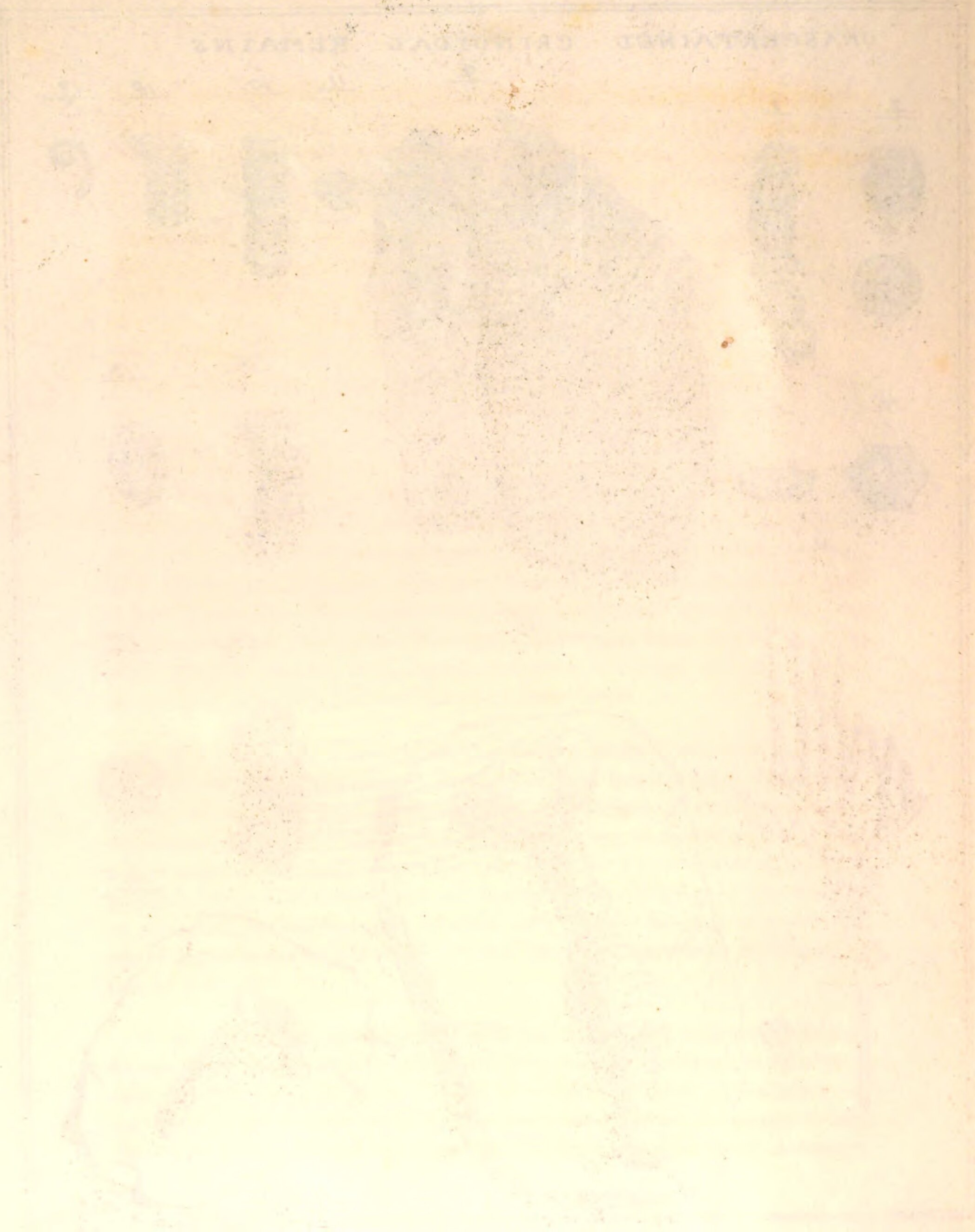
1. The superior portion (fig. 6.) of a Crinoidal animal, probably belonging to the genus *Cyathocrinites*, from the Mountain limestone of the Mendip Hills. It is on account of its decomposed surface that I am unable to speak positively as to its generic character. What may be traced proves it considerably analogous to *Cyathocrinites planus*, but having fewer joints interposed between the cuneiform ones from which the fingers and continuations of the hand proceed. Should it belong to that genus and prove a distinct species, I should feel inclined to name it *CYATHOCRINITES ABBREVIATUS*.

2. The pelvis of a *Platycrinites* (fig. 4. and 5.) formed only of two plates, presenting at their upper edge six excavations, and hence indicating the existence of six scapulæ, from the Black Rock, near Bristol. I consider this as a monstrous variety of *Platycrinites lævis*, analogous to those irregularities of nature which occasionally render the column of the *Pentacrini* tetragonal and hexagonal as noticed before, and which sometimes produce a six-fold division of the pelvis in *Encrinus moniliformis*, as noticed by *Rosinus*, or a four-fold one of *Apiocrinites rotundus*, of which I have seen a specimen in the possession of a friend.

3. A column or auxiliary side arm (fig. 1. to 3.) of a Crinoidal animal, formed of barrel-shaped joints externally tuberculated, articulating by striated surfaces, and having in the centre a round nourishing vessel or alimentary canal. From some place in Germany, and on a slab of Mountain limestone from the river Swale in Yorkshire, having alongside of it fragments of *Actinocri-*

UNASCERTAINED CRINOIDAL REMAINS





nites and of the column number 8, below. Mr. PARKINSON represents a single columnar joint of this Crinoid in his *Org. Remains*, Vol. II. t. 13. fig. 69. **DOLIFORMIS** would be a good specific name after ascertaining the genus to which it belongs.

4. Crinoidal column (fig. 10. and 11.) formed of moniliform joints alternately larger and thicker, articulating by a striated rim, having a central round alimentary canal. A few small auxiliary side arms proceed from the larger joints. Locality unknown, apparently Mountain limestone.

5. Portion of a crinoidal auxiliary side arm, (fig. 12. and 13) formed of thin joints, articulating by a radiating rim, and in one instance a series of them, each terminating in a tubercle on one end of the longest diameter. From the Mountain limestone at the Mendip Hills.

6. Portion of a crinoidal auxiliary side arm, (fig. 14. and 15.) whose joints are of equal thickness, articulating to each other by striated surfaces. The external circumference shows a series of tubercles surrounding each joint, and several folds the vestiges of muscularity. From the Derbyshire Mountain limestone, and also figured in MARTIN'S *Pet. Derby.* t. 4. fig. 10.

7. A nearly round, remarkably smooth, pentacrinal column, (fig. 7 and 8.) formed of joints swelling out at their point of articulation to each other. This might be easily mistaken for an auxiliary side arm of *Actinocrinites*, were it not for the pentapetalous semi-striated articulation. I feel inclined to consider this column as appertaining to a pentacrinite, claiming a specific distinction, and should propose for its name **PENTACRINITES LEVIS**. Locality unknown; probably lias.

8. A crinoidal column, formed of moniliform joints, articulating by surfaces striated near the circumference. (fig. 9.) I never saw the superior portion of this crinite sufficiently perfect to display the pelvis and plates resting on it. A slab in the possession of Mr. R. BRIGHT, from the transition limestone on his estate, near the Malvern Hills, shows some fingers of this species. Mr. G. HAWKER has also a specimen from Dudley, showing the column and several fingers; and Mr. C. STOKES has transmitted me the drawing of a nearly similar specimen from the same place. From the analogy of these fingers to those of *Actinocrinites triaconta dactylus* and some other characters, I feel

inclined to consider it as belonging to that genus, naming it *ACTINOCRINITES MONILIFORMIS*, from the moniliform figure of its columnar joints, which preserve that shape throughout the column, although alternately larger and smaller near the pelvis. It is a large species appertaining to the transition and perhaps Mountain limestone, in which latter I have seen columns much resembling these. It must be widely distributed, as I have seen its columns on slabs of Mountain limestone from Swaledale, in Yorkshire, and on slabs of transition lime from Foulhope, the Malvern Hills, Gliddenhill, Shelly Island, Lake Huron, in Canada, and Melville Island, in the arctic regions. Mr. PARKINSON, who has seen the specimen in Mr. HAWKER's collection, informs me that it is illustrative of what he calls the Plumose Encrinite, and which was in Sir ASHTON LEVER's collection.

9. In the green sand formation, near Warminster, occur portions of a Pentacrinite, (fig. 18.) with a rounded column, showing very little of the effects of contraction in the interstices between the pentapetalous formations. These columns display in some specimens an alternation of thicker and thinner joints, and in others show a uniform thickness, the result of growth, as explained before. At intervals larger joints are interposed, marked externally by five transverse oblong depressions, from which round auxiliary side arms proceed. I consider this a distinct species, to which I would assign the name *PENTACRINUS MONILIFORMIS*, from the bead-like shape of the interposed large joints.

10. Very minute Crinoidal auxiliary side arms no thicker than a hair, occur with retepora, &c. on slabs of Mountain limestone, from Mitchel Dean. (fig. 19.) They are excessively small, show but obscure marks of organization, and are changed into spar. One specimen is bent into a hook.

11. I understand Mr. JAMES SOWERBY, has found Crinoidal remains in the London clay at Highgate, which I have not seen, and hence am unable to speak to their generic and specific identity.

12. In the slaty gray-wacke where it comes in contact with the lower beds of the transition limestone, occur the impressions of numerous organic remains and Crinoidea, the substance of which has been decomposed and removed. It is perhaps owing to a contraction or compression of this slaty formation, that the Crinoidal impressions thus found have generally an elliptical form. Where

the articulating surfaces of joints were concave, striated, and had a small alimentary canal, they have produced slightly convex impressions distantly resembling a limpet, and thus probably have led to the assertion of the occurrence of that shell in beds below transition limestone.

13. Much has been said by the older writers on fossils regarding a petrefaction called by them screwstones, which, although at first sight much resembling a screw, show on examination that the incision around them is not spiral but circular. They prove on reference to the columns of the Crinoidea to be casts, formed in the alimentary canal, as in a mould, either by a harder substance such as chert, which from its want of affinity to the surrounding substance did not incorporate with it, and resisted decomposition after the destruction of the column; or by the infiltration of a highly saturated calcareous menstruum which filled the empty cavity, formed laminar spar, and took its markings gradually, being prevented by the intervention of the alimentary vessel itself from incorporating with the column, and enabled to preserve its form after the decomposition of the column. I have seen casts in chert of the round (*Actinocrites*, &c.) and pentagonal (*Cyathocrinites rugosus* and *Rhodocrinite*) alimentary canal of crinoidal columns, which displayed the effects of sphincter contraction, and in which where the cherty matter had infiltrated between the radiating adhering surfaces, a thin and elegantly striated rim surrounded the thickest part of the cast. I also have a fine calcareous cast formed in the upper part of the alimentary canal and the abdominal cavity of *Apio-crinites rotundus*, where the now spathose matter has also entered the space between the pelvis, costæ, and scapulæ.

The existence and preservation of the muscular portion of the Crinoidea, has been proved by Mr. PARKINSON, who placed well preserved portions of columns in diluted acid, and which gradually removed the calcareous matter, and left the fine animal pellicle behind.

Since the printing of the description of the Crinoidea, I have received BARON VON SCHLOTHEIM's *Petrefactenkunde*, Gotha 1820. In it he gives page 327,

an account of the encrinital remains in his collection, applying names to those varieties which appeared to him entitled to specific distinction. And although he furnishes no anatomical details, yet his localities and synonymes are sufficiently valuable to induce me to present the following extract from his work :

He places the family, according to **BLUMENBACH**'s arrangement in the order of Crustacea, (meaning by that term those radiated animals which have crustaceous plates, an application which cannot be admitted in our system, where it has been appropriated to the crab tribe) forming of it two genera, *Pentacrinus* and *Encrinus*. He observes in a note, that they do not belong to the Zoophytes with which **LAMARCK** has arranged them, but rather form a link between the Crustacea and Zoophytes. In this I fully agree with him.

1. **PENTACRINITES VULGARIS.** Is our *P. CAPUT MEDUSÆ*. The Baron gives the following additional synonymes and reference. *VORTICELLA PENTAGONA* **ELLIS** and **ESPER** *VORT.* t. 3. fig. 1. — **GUETTARD** *NUM.* vol. III. *Palma animal ACTA PARIS.* 1761. t. 8. p. 392. **PARRA.** *HIST. NAT. HAVANNÆ,* p. 191. t. 70. **OCKEN**'s *Zoologie*, p. 108. He mentions but one new locality, which is the *Muschelfloetz kalkstein*, our lias, in the environs of Waltershausen. The Baron observes that the fossil resembles the recent species, and that he possesses columnar fragments in flint, which I suspect is the variety mentioned by me p. 55.

2. **PENTACRINITES BRITANNICUS.** Our *P. BRIAREUS*. The Baron gives the following additional synonymes and reference. *VORTICELLA PENTAGONA* **DAVILÆ.** *ESP. PETRIF.* t. 6. A. **BLUMENBACH**'s *Abbildungen natürlicher Gegenstände*, 70. 1. a. und. b.

3. **PENTACRINITES EXCAVATUS.** From the *Uebergangkalkstein*, (transition limestone) in the neighbourhood of Prag. The Baron possesses only some roots from which many columns (*Hauptarme* Main Arms) proceed; and quotes **SCHROETER**'s *Einleitungen zur Naturgeschichte der Petrefactenkunde*, T. 3. p. 336. t. 4. fig. 2. It is distinguished from all other species of Encrinites by its plate-like concave joints, ornamented externally with a fine projecting rim. The Baron further says that, according to verbal information, its upper columnar joints articulate alternately with pentagonal ones, displaying star-like markings. Yet he suspects that it is not a Pentacrinite, but Encrinite; I

should almost suspect it to belong to a species related to *Cyathocrinites quinquangularis*.

The Baron states that he is in possession of many pentacrinal columnar fragments which appear to appertain to other species, and conjectures that if KNORR's Pentacrinite, p. 1. t. 11. c. (our *P. subangularis*) may be considered distinct, the distinct species may at least amount to three. He confirms my assertion in this monograph, that perfect specimens alone can be satisfactorily referred to as furnishing correct characters of the column, which materially differ near its summit.

4. *ENCRINITES RAMOSUS*. From the *Hoehlenkalkstein* or cavern limestone, not as yet precisely identified with any of the British strata, in the environs of Gluecksbrunnen and Liebenstein, in Meiningen. His description, which by no means tends to furnish a specific character, leads me to suspect with the Baron, that the specimen described by him presents the summit of an encrinite, its hands and tentaculated fingers.

5. *ENCRINITES RAMOSUS MAJOR*. From Muggendorf, and the Canton Basel, resembling the former, but larger.

6. *ENCRINITES ECHINATUS*. From the limestone at Basel; in pebbles penetrated by iron from Berrach, in Burgundy; in hornstone from Amberg.—From his reference to KNORR, p. 1. t. 26, (say 36.) fig. 8. I consider this to be a variety of *Rhodocrinites*, somewhat analogous to the Mitchel Dean variety. He further refers to BOURG, t. 58, fig. 413. and 417.

7. *ENCRINITES MESPILIFORMIS*. From Gingen, and Heydenheim, in Suabia; probably the jura formation. If I may judge from the figure (PL. XXIX. fig. 5.) the Baron furnishes, and which I have copied in my plate ADDITIONAL CRINOIDAL REMAINS, (fig. 17.) I must confess I discover but a very general similarity between the columnar joints of this species and the Bradford Encrinite, (our *Apiocrinites rotundus*) of Mr. PARKINSON, to whom he refers, V. II. t. 14. fig. 1 to 3; but I agree with the Baron in pronouncing it a distinct species, probably not occurring in England.

8. *ENCRINITES PARKINSONII*. OUR *APIOCRINITES ROTUNDUS*. The Baron

refers to Mr. PARKINSON's Org. Remains. V. II. t. 16. fig. 4. and states that it does not occur excepting in England.

9. ENCRINITES CARIOPHYLLITES. My EUGENIA CRINITES QUINQUANGULARIS, from Swiss in ~~aelterm~~ **Kalkstein**, probably lias.

10. ENCRINITES ECHINOIDES. I apprehend this to be my RHODOCRINITES VERUS, on account of the author's reference to PARKINSON, P. II. PL. XV. fig. 7.

Var. á. from Gothland.

Var. b. from the Eiffel.

11. ENCRINITES VERUCOSUS. My CYATHOCRINITES RUGOSUS.

12. ENCRINITES ORTHOCERATHOIDES. The Baron gives the locality from Gothland and Neualp, in Swiss refering to HOFEL, t. 7. fig. 2. 4. **Merkwuerdigkeiten der Landschaft Basel**, t. 20. fig. 33. t. 21. f. H. KNORR, t. 2. t. G. 4. fig. 1. 2. SCHROETER's Cat. II. VII. B. 20.

Var. á. Encrinites hyppuroides, from Bisance, in Bourgogne.

The description of these varieties are not sufficiently specific to enable me to assign their synonymes in the present treatise, and the figures referred to as far as I know them, represent only bases and columns.

13. ENCRINITES LILIFORMIS. My ENCRINITES MONILIFORMIS. Additional localities from the **Muschelstetzkalkstein**, (our lias) at Heimberg by Goettingen, from Brunswig, from the Lohberg by Tonna, and Krauberg by Gotha. The Baron acknowledges that the animal has no auxiliary side arms, but states that he has two specimens which show thread-like, toothed, slender tentacula, apparently proceeding from a crust surrounding the column. What he means by this I am not able from my own observations to pronounce.

14. ENCRINITES CALYCULARIS. See a copy of the Baron's figure (PL. XXIX. fig. 4.) in my plate, ADDITIONAL CRINOIDAL REMAINS, fig. 16. It comes from the marley beds connected with and probably reposing on the chalk at Aachen, and is, I apprehend, related to Eugenia crinites.

15. **ENCRINITES EPHITONIUS.** See page 13 of this monograph. The common screw stone or cast formed in the alimentary canal of the Crinoidea, and exposed by the decomposition of the column. Why the author should have applied a specific name to the casts appears to me singular, since all the Crinoidea that have a round alimentary canal will form screw stones.

Of all the above varieties, the Baron has specimens in his collection, but he subjoins the following list of others, which, though not in his own museum, he considers worthy of specific distinction:—

1. **ENCRINITES LORICATUS.** Our **ACTINOCRINITES TRIACONTA DACTYLUS.**

2. **ENCRINITES TESTUDINARIUS.** Our **MARSUPITES ORNATUS.**

3. **ENCRINITES FLOREALIS.** PARKINSON'S Org. Remains, vol. 2. t. 13. fig. 36. and 37. an Echinite mistaken for an Encrinus, and found by me also in the Mountain limestone of the Mendip Hills. Specimens of it are also in R. BRIGHT'S, Esq. collection from Derbyshire.

4. **ENCRINITES TESSERATUS.** V. Huepsch, t. 4. fig. 28. and 29, from the Eiffel.

5. **ENCRINITES PHYTOLITES.** V. Huepsch, t. 4. fig. 30. from Lothringen.

6. **ENCRINITES PICTUS.** Bourg, t. 58. fig. 207. to 209.

As the Baron gives no description of these, and as I have not seen the figures to which he refers, I am unable to give my opinion on them.

OBSERVATIONS

ON THE

GENERA,

Comatula, Euryale, Ophiura, and Asteria.

INTRODUCTION.

MY inquiries into the anatomical details of the Crinoidea, necessarily conducted me to the investigation of several other organic remains, hitherto considered as belonging to the Encrinites, and also to an examination of the animals arranged by LINNÆUS in the genera Asteria and Echinus, since these appear in some parts of their structure, more or less allied to the former. I was still further animated to enter into the details of this investigation, since M. CUVIER asserts in his *Regne Animale* (vol. iv. p. 8.) "that their bony arrangement deserves to be studied;" which made me conclude that this part of anatomy has been as yet left untouched by that great naturalist.

Of the Linnean genus Asteria, M. LAMARCK has formed a family to which he has assigned the name *Stelleridæ*, comprehending four genera, arising from the subdivision of the above Linnean genus. With a view to discover the animals which form a link between the Crinoidea and Asteria, I dissected several individuals of the family *Stelleridæ*.

The comparatively large abdominal cavity of the Crinoidea inarticulata, its protection by plates, and their slender connection to the column, seemed to indicate that an analogous animal might exist in nature without being provided with a column or organs of permanent attachment, and therefore capable of locomotion. I at first apprehended that this might be detected in the Euryale, but soon found that a greater conformity in organic construction ought to exist, before the transition or link could be considered as perfect. I therefore again referred to the general conclusions resulting from my previous inquiries relatively to the Crinoidea, of which it will be necessary in order to guide our further progress to subjoin in this place the following brief recapitulation.

The Crinoidea are animals provided with a column formed of numerous joints, surmounted by five articulated arms, which enclose between them at their base the viscera in a cuplike cavity.

The portion that encloses the viscera, although it may be considered as a beginning of the arms, yet by being laterally connected is deprived of expansion, or rather possesses it only in a very limited degree; hence it varies its figure in conformity to the size of the viscera, which viscera must be again conformable (in accordance to general Zoological principles) to the nature and quantity of food requisite to the animal economy.

It is this conformity of the exterior covering to the viscera, which, perhaps, chiefly occasions the gradual transition from articulating joints (Crinoidea articulata) to plates adhering only by sutures (Crinoidea inarticulata.)

The analogy between joints and plates at the base of the arms, is preserved by the similarity in position and number of those pieces which in both cases have been denominated as costals and scapulæ, as in the Crinoidea articulata, and the genera Actinocrinites and Rhodocrinites, of the division Crinoidea inarticulata.

The muscular action extended from the pelvis to the arms, is transmitted in a similar manner in all the Crinoidea, only that in one instance (the articulata) it is effected from joint to joint by means of attachment to the articulations, and in the other (the inarticulata) over the plates by means of adhesion and sutural attachment.

In those Crinoidea where the costals are wanting, action is continued over interposed intercostal plates or the enlarged scapulæ, where as in Platycrinites these are made subservient to the use of costal plates. Where the regular number of costal plates exists, and intercostal, interscapular, or pectoral plates occur, as in Actinocrinites and Rhodocrinites, these can only be considered as analogous (yet infinitely more conspicuous and developed) to those plates that cover the integument between the second costal and scapulæ of the pentacrinite.

In the Crinoidea, generally the articulation of the arms is to the scapulæ resting on the costals, which are inserted on the pelvis, whose joints adhere to the column, and enclose a small perforation in the centre that leads to the alimentary canal.

The alimentary canal is only a continuation of the stomach, (a sort of coecum?) carrying nourishment to the further end of the column, and as it proceeds, distributing it to the auxiliary side arms, by means of minute vessels under the epidermis.

An integument protected by numerous minute plates extends over the abdominal cavity, the channel in the arms, fingers, and tentacula, furnishing a protection to the viscera and vessels extending under it.

It is this plated integument, where spreading over the abdominal cavity, which has in its centre the mouth of the animal, apparently formed for suction and gorging, and hence its surrounding muscle is able to protrude it under the form of an elongated proboscis.

Numerous tentaculated fingers surround the mouth, and hence prove by the closeness of the apparatus so provided, that the food detained by them must be very small.

A mouth capable of being elongated into a proboscis, and fingers constructed for detention, indicate that the animal watched for its prey, and took it in from above.

A perforation extending through the centre of the arm, finger, and tentacular joints, indicates the passage of a nourishing vessel, analogous to those extend-

ing through the auxiliary side arms, which vessel was perhaps surrounded by a cuticle possessing the qualities of a nerve and muscle ; as appears very probable in an animal where the nerves must have been so minutely distributed.

On examination of the conformation of the analogous parts in the *Stelleridæ*, it is at once proved,

That in the genera *Ophiura*?* *Asteriæ*, and *Euryale*, the ossicula forming the arms proceed from an ossicular arrangement surrounding the mouth, whereas in the *Crinoidea* the system of joints supporting the arm proceed from the base of the cup containing the intestines, and are only loosely connected with the muscle surrounding the mouth, by the plated integument covering that cup.

In the three genera mentioned, the mouth is pentagonal, and provided with teeth, of which there are no traces in the *Crinoidea*.

The following characters appear distinctive between the three above stated genera of the *Stelleridæ*, but still not such as to approximate any of them particularly to the *Crinoidea*:—

In the genus *Ophiura*, the abdominal cavity extends beyond the mouth in a subglobose manner.

In the *Asteria*, the abdominal cavity extends laterally over the ossicular arrangement of the arms to admit ten coeca.

In the *Euryale*, the protruding semiglobular abdominal cavity is formed by ten plates, each two serving as a stay to an arm ; thus if the arms were removed, these animals would exhibit by this arrangement of their plates in ten divisions, and the teeth, a transition to the *Echini*.

In the *Ophiuræ*? *Euryale*, and *Asteriæ*, there exists no perforation in the arm joints, hence the vessel passing through it in the *Crinoidea* is omitted or differently placed.

The inner lateral angles of the arms of the *Asteriæ* being provided with

* I here add a mark of interrogation, not having had opportunity to examine *Ophiura* sufficiently in its anatomical details, and judging therefore from delineation only.

numerous spines and retractile muscular feelers, indicate a different mode of detaining food and bringing it to the mouth, which is confirmed by the *Ophiuræ* and *Asteriæ* crawling along with the mouth downwards, catching their prey, and pushing it on along the space or groove between the inner lateral angles of the arms to the mouth.

Although the numerous fingers of the *Euryale*, resulting from the repeated bifurcation of the five arms, are well calculated to detain prey caught in a floating attitude, yet the want of tentacula, still removes them from the *Crinoidea* in organization.

These and other facts (too numerous to be incorporated in the present monograph, but which, should circumstances favour my researches and give them a degree of maturity, I intend at a future time to lay before the public) resulted from my enquiries.

The comparison of these results with those obtained from the *Crinoidea* made me anxious to examine the *Comatulæ*, the only remaining genus of the *Stelleridæ*, which from its general aspect seemed to promise a nearer approach than any of the preceding to the family of *Crinoidea*, and in which I therefore still hoped to find this connecting link of which I was in search. The results were even more favourable than the first appearances had given me reason to hope, presenting, indeed, a conformity of structure almost perfect in every essential part, (excepting the column which is wanting, or at least reduced to a single plate) and exhibiting an animal which would be defined with sufficient precision as a *Pentacrinus* destitute of the column. The details of this genus follow.

GENUS. COMATULA.

An unattached animal, having a depressed orbicular body, formed of calcareous plates enclosing the viscera. The mouth in the centre (capable of being elongated into a proboscis) surrounded by tentaculated arms or fingers composed of numerous joints; near the base of the body, below the fingers or arms, many jointed auxiliary side arms terminating in a hooked point.

Observation.

M. LAMARCK applies the name *Comatula* (derived from coma, a lock of hair, in allusion to the resemblance the cluster of auxiliary side arms bear to it) as a generic name, to a series of animals once incorporated in the *Lin. Gen. Asteria*. **Dr. LEACH** applies the name *Alecto* to the same series of animals, describing three species in his *Zoological Miscellanies*. Yet as his character is inferior in precision to that of **LAMARCK**, as the name *Alecto* is, in its application by **Dr. LEACH**, simply equivalent to that of *Comatula*, as his generic character does not exhibit any new division of the genus *Comatula*, and as it seems desirable to avoid the unnecessary multiplication of scientific nomenclature, I have retained the latter. But as the characters given both by **Dr. LEACH** and **LAMARCK** were drawn up from a comparison with the family *Stelleridæ*, and do not allude to those parts of its organization which mark the link between it and the *Crinoidea*, I considered it necessary to furnish the above new generic character.

The *Comatulæ* are not very numerous, but considerably distributed through the various seas on our globe.

At first sight the observer acquainted with the formation of *Pentacrinus Caput Medusæ*, will be struck with the resemblance the *Comatulæ* bear to the superior portion of that animal. The tentaculated fingers and auxiliary side arms bear so striking a resemblance, that we are at first led to suspect that

we shall find beneath the cluster formed by the latter, an abbreviated column from which they proceed.

On dissection, we find that the Comatulæ have series of calcareous secretions or ossicula exactly similar in their general plan and arrangement to the Crinoidea, and especially to the genus *Pentacrinus*, intended like theirs to sustain muscular action.

PENTAGONAL PLATE. At the base of the subglobose body of the Comatulæ, exists a pentagonal unperforated plate, slightly convex externally, and concave on the inside. It is analogous in situation to the first columnar joint of the Crinoidea, but as it is not required to transmit the passage to the alimentary canal (no prolongation of the column existing in this animal) it is without central perforation.

The PELVIS. On the margin of the pentagonal plate, rests an annular plate, resembling the rim of a basin, and forming with the former a basin-like cavity. It appears to occupy the place of the pelvis of the *Pentacrinite*, it is consequently necessary that it should increase in proportion with the contained viscera, without altering materially its basin-like form; yet as it is not formed of separate plates, and cannot therefore increase laterally their margins, another mode has been adopted, as I shall explain in proceeding. At the upper edge this pelvis-like plate is pentagonal, having between each of the angles a horse-shoe-like impression for the insertion of the first costal joint. Externally numerous auxiliary side arms proceed from the pelvis-like plate, which when they are broken off or removed, show the exterior surface of the plate marked with concave impressions (the points of their insertion) each surrounded by a hexagonal rim more or less perfect, according as their situation is near the central or marginal circumference of the plate.

AUXILIARY SIDE ARMS. Across the middle of each of the concave impressions on the pelvis-like plate, is a transverse ridge slightly perforated in the centre on which the first joint of the auxiliary side arm is attached. These arms, the formation of their joints, and their hook-like termination, resemble in every particular those of *Pentacrinus caput medusæ*, only that they are much shorter, and formed of a less number of joints.

GROWTH OF THE PELVIS AND AUXILIARY SIDE ARMS. It is perhaps not

one of the least pleasures that an admirer of comparative anatomy enjoys, when he finds that results which he acquired from one series of animals, will apply also to those which most nearly approach them in the analogy of their structure. The gradual increase of the plates or joints of the Crinoidea inclosing the abdominal cavity, took place by an extension at their lateral edges, to afford the room required by the viscera in the growth of the animal. The producing of auxiliary side arms, and reproducing of parts lost, demonstrate the formation of their joints, by a gradual secretion of calcareous matter from the involving muscular covering. These are facts which, since the Comatulæ are so nearly in conformity in their general structure to the Crinoidea, ought also to be demonstrable in their organization.

The annular basin-shaped plate, which may be considered as the pelvis, appears principally to increase towards its upper margin, as it is on this side only that new auxiliary side arms can be traced as growing out of it, hence its proportions become gradually deeper. This pelvis is (as has been already observed) covered by numerous circular impressions, into which the side arms are inserted; these circular impressions are surrounded by hexagonal rims, the result of an abundant secretion of calcareous matter from the muscular integument which surrounds and strengthens the adhesion of these side arms at their base. The hexagonal form of these rims appears, as in many other instances, to arise from the mutual pressure and accommodation of the contiguous circles to each other. As this pelvis increases towards its upper edge, new arm joints are there protruded. I have in my possession specimens in which near the upper rim new cavities are formed, having in their centre minute, undeveloped, auxiliary side arms, entirely similar to those of *Pentacrinus caput medusæ*, and where also the claw-like termination has not yet made its appearance.

The limited number of Comatulæ which I have had an opportunity of examining, have not enabled me to ascertain whether the perforation in the ridge which traverses each indentation in the pelvis passes through into the abdominal cavity, or whether the vessel arising from it branches off laterally, and obtains its supplies from vessels under the epidermis which covers the plates externally.

Each of the five depressions at the upper rim of the pelvis is of a horse-shoe-like figure, in which the first costal joint rests, to this the second costal joint adheres, and on that a scapula is attached. The two **COSTALS** much resemble

the second costal joint of *Pentacrinus caput medusæ* in general figure, yet here the first costal joint is externally so much overlaid by the second, that it is only visible at its lateral margins.

The *SCAPULÆ* resemble also those of that *Pentacrinite*, but are much more angularly pointed at their superior surface, and are also tied laterally together by an integument.

From each of the *scapulæ* in the different species proceed either two arm-like fingers, or two arms; each of the latter formed of a common and cuneiform joint, from which, on one side the first finger, and on the other side a continuation of the arm sets off, which, again, by the intervention of cuneiform joints, divides into two or more fingers, and thus forms a hand like in other *Crinoidea*. Each joint of the arms and fingers sends off from alternate sides a tentaculum formed of many articulated small joints, resembling in formation those of *Pentacrinus caput medusæ*.

An integument extends over the abdominal cavity, the groove in the arms, fingers, and tentacula, and is, like that in *Pentacrinus*, also protected by numerous minute calcareous plates. In some species of *Comatulæ*, this integument extends laterally in a fimbriated manner, connecting the tentacula, and sometimes portions of the arms and fingers near their origin, together. In these cases the integument is here excessively thin and transparent, having at the margin of its fimbriæ a few minute plates probably to add to its strength. I apprehend that this lateral extension of the integument may probably have existed in some of the *Crinoidea*, but it is almost impossible that we should expect to detect so fine a membrane in a fossil state; should it however, favoured by peculiar circumstances, ultimately be detected, I feel confident it would furnish a good specific character, and perhaps lead to the distinction of species at present apparently similar.

An insufficient supply of specimens, and want of opportunity to examine different species, has prevented me from ascertaining whether the groove in the arms and fingers extends also along the tentacula. In the fimbriated *Comatulæ* I should apprehend it does not, since each of the joints forming the tentaculum in those which I have seen has only a concave impression near the base, where the fimbria is attached more firmly than above this depression. Hence I appre-

hend that the vessel passing along the groove in the tentacula of the Crinoidea, and probably also in the unfimbriated Comatulæ, is in these placed near the exterior margin of the fimbriæ, where it is protected by the minute plates noticed before.

I have not been able to examine the Comatulæ while alive, but the observations made by M. PERRON as stated by M. LAMARCK in his *Animaux sans Vertebres*, are so satisfactory that I feel no hesitation to subjoin them in this place, more especially, as that naturalist made them unprepossessed by any idea of the resemblance which they bear to the Crinoidea. He notices the power which the animal has of extending its mouth into a kind of proboscis, which, reasoning from analogy, confirms the idea which I have before expressed on the probability of a similar extension of the mouth of *Pentacrinus caput medusæ*. He also states that the animal suspends itself by its auxiliary side arms from fuci or branches of polyparia, watches for its prey and detains it with its spreading arms or fingers, guiding it to its mouth with its auxiliary side arms.

LAMARCK has described eight species, which will require a new specific character in conformity to the generic one furnished above; but as his descriptions are not sufficiently detailed, to enable me to draw from them that information requisite to remodel them in this manner, as the major part were procured by M. PERRON and LE SUEUR, and hence exist only in the French museums, which I have no opportunity of seeing, I wave entering for the present further on the subject.

I have had only an opportunity of examining a few specimens of a species which occurs in Milford Haven, and which I have named

COMATULA FIMBRIATA.

Specific Character.

A Comatular animal with an orbicular depressed body, provided with numerous auxiliary side arms, and ten finger-like arms surrounding the mouth which is in the centre. The arms and tentaculæ are fimbriated, and in part tied together by a thin transparent membrane, bordered at its outer margin with minute scales.

Observation.

LAMARCK describes a small Comatula as *C. fimbriata*, found by M. PERRON and LE SUEUR in the eastern seas, stating that it somewhat resembles the *Stella Barbata* of LINKIUS, t. 37. No. 64. PENNANT quotes the same figure for his *Asterias decacnemos*, but in his representation (PL. xxv.) does not express the fimbriated membrane, nor does his figure show the organic detail correctly: he also represents a pentagonal mouth which I could not detect in my dried specimens; hence I do not know how far those figures and quotations afford synonymes or reference.

A species of Comatula appears to occur in the Solenhofe slate, it has been figured by KNORR (PL. II. L. I.) and by von SCHLOTHEIM in his *Petrefactenkunde*, as *Ophiurites pennatus*, p. 28. (fig. 1. and 2.) but neither of these figures exhibit that accurate attention to organic formation, which alone can enable us to furnish a specific character.

OBSERVATIONS

ON THE

GENUS

Marsupites, or the Purse-like Animals.

Generic Character.

An unattached animal with a subglobose body containing the viscera protected by calcareous plates, of which that in the centre at the base is angular, having a series of costal plates resting on it, admitting intercostals at their superior angles, these giving insertion to the scapulæ from which the arms proceed. Space between the scapulæ covered by an integument, protected by numerous small plates.

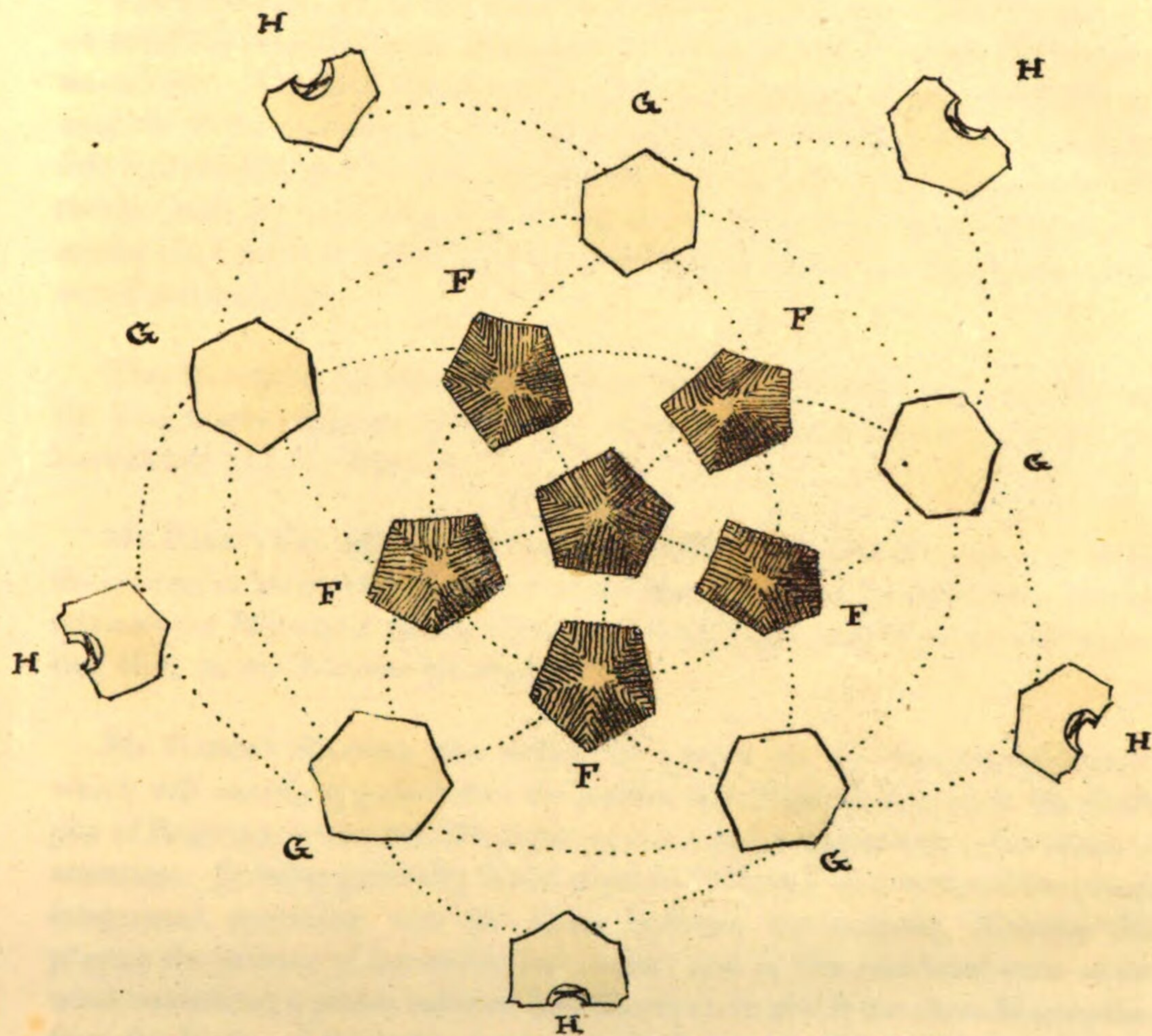
Observation.

The Marsupites have not as yet been found in a living state, and may probably be considered as extinct animals. They furnish an instance, how much an examination of the organic remains in the strata of the earth, enlarges our zoological knowledge, tends to display new mechanism, and exhibits new links, which render the transition between the species regular and gradual.

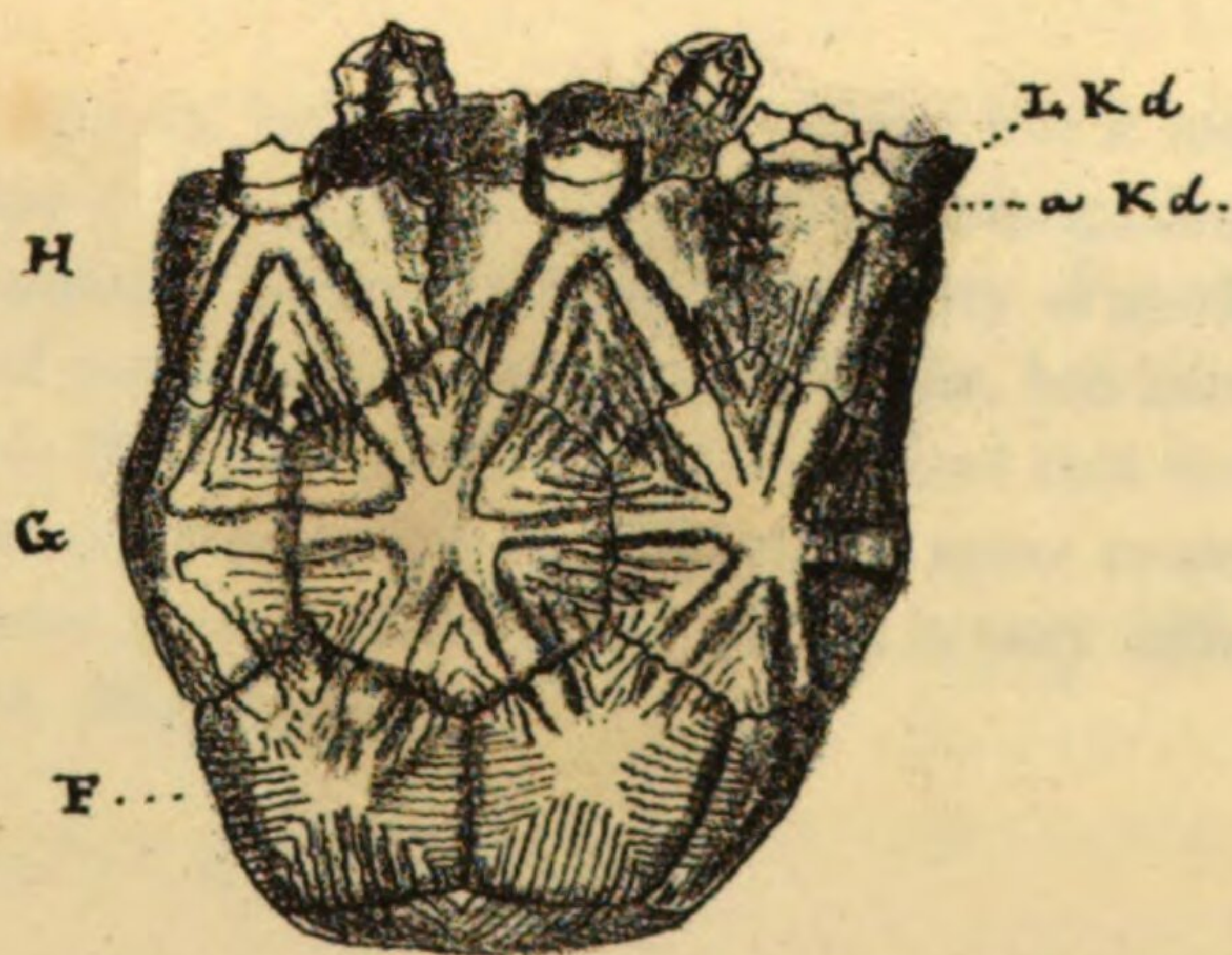
Thus the want of the column formed of many joints, separates the Crinoidæ from the stelleridæ.

GENUS .

MARSUPITES



MARSUPITES ORNATUS



Miller del

MANUSCRIPTS

CENUS

EXOTIC PLANTS

PLANTS IN CULTURE



The Comatulæ, as an approximating link, retaining the auxiliary side arms observable in the Pentacrini, have them proceeding from the pelvis, and possess no column. Yet these auxiliary side arms, the plated integument extending over the abdominal cavity, having in its centre the mouth capable of elongation into a proboscis, and the articulation and formation of the arm joints and tentacula, indicate their retaining too great an affinity to the Crinoidea than to render the transition to the Euryale satisfactory, and some intermediate link seems still wanting.

The Marsupite, by having no column, no auxiliary side arms, and retaining the integument, appears to form the immediate link between the Crinoidea inarticulata and the Euryale.

Mr. PARKINSON, although perhaps somewhat inconsistently, after including the column in his generic character of the Encrinites and Pentacrinites, has yet retained the Marsupite among them, and furnished a good figure and description of it, as the Tortoise Encrinite.

Mr. GIDEON MANTELL, the author of a work on the Southdown fossils, which will shortly appear before the public, has (from his vicinity to the chalk pits of Brighton, where the Marsupite occurs) given its remains a due share of attention. It being generally found deprived of arms, and without the plated integument spreading over the space between the scapulæ, (thereby displaying the interior of the abdominal cavity) and in this mutilated state somewhat resembling a purse, induced Mr. MANTELL to give it the name Marsupites, from the Latin. I think this name so well chosen, that I have taken the liberty to adopt it.

I know of but one species belonging to this genus; but it may be well to observe that, on account of an imperfect anatomical investigation, Cyathocrinites rugosus, of the transition limestone, from a similarity of markings on the plates and conformity of shape in the costals and scapulæ, has been considered as a species belonging to this genus, although it is evident that this Cyathocrinite possessed a regular column, which the Marsupite never could have done; and that the arrangement and number of the plates is very different in that Cyathocrinites and the Marsupite.

I. SPECIES. MARSUPITES ORNATUS.

ORNAMENTED PURSE-LIKE ANIMAL.

Specific Character.

A Marsupial animal, having the central plate, at the base of its subglobose body containing the viscera, pentagonal, supporting at its edge five similar costals, which admit at their superior angles five hexagonal intercostals, into the angles of which five scapulæ are inserted sending off the arms.

All the plates ornamented by ridges proceeding from the centre, and forming angular markings near the corners.

Synonymes.

TORTOISE ENCRINITE. PARKINSON'S Organic Remains, Vol. II. PL. XIII. fig. 24. MANTELL'S Manuscript on the Southdown fossils, t. XVI. fig. 6. to 10. 14. and 15.

Locality.

Offham Chalk-Pits, near Lewes ; Clayton Chalk-pits, Hurstpoint, Sussex ; Preston Chalk-Pits, near Brighton ; (for the above localities, I am indebted to Mr. MANTELL) ; Chalk-Pits of Kent ; and Chalk-Pits, near Warminster.

Description.

I have given the specific name ORNATUS to this species, (the only one known to me as belonging to this genus) on account of its plates being beautifully ornamented with radiating markings. I am indebted to GIDEON MANTELL, Esq. of Lewes, in Sussex, whom I had occasion to mention in my observations on the genus Marsupites, for a fine specimen of the body of this animal, which has enabled me, in conjunction with an examination of some

of the delineations intended to illustrate his work, (which he obligingly lent me) to draw up the following description :—

The **CENTRAL PLATE*** of the Marsupite may be considered as occupying a similar situation to those plates which form the pelvis in the Crinoidea inarticulata, since the other plates which cover the body of the animal are attached to it in a regular series. But being single only, not perforated in the centre, and having no concave impression at its exterior surface, we discover at once a striking dissimilarity, which points out that there existed no passage through the plate to an alimentary canal beyond it, and that consequently no columnar joint could have been attached to it; an inference which is confirmed by observing that the lower surface of this plate exhibits no mark of adhesion for a column. It is of a pentagonal form, somewhat elevated in its middle, marked at the exterior surface with subcrenulated ridges, arranged like those of *Cyathocrinites rugosus*, as described page 90.

FIVE PENTAGONAL COSTAL PLATES adhere to the lateral edges of the central plate, and are marked externally like it.

In the superior angles formed by the costal plates, are admitted five hexagonal **INTERCOSTALS**, also marked like the latter; these, however, have in addition to the former markings, four conspicuous ridges radiating from the centre to the two lateral edges (which serve for the more firm adhesion of the intercostals to each other) and to the superior margins (where the pentagonal scapulæ adhere) over which they extend to the horse-shoe-like impression at their summit.

The radiating subcrenulated ridges on the plates, the folds just noticed, and the lateral adhesion of plate to plate by simple sutures, plainly indicate that a muscular integument extended over these calcareous plate-like concretions; that this muscular integument was capable of contraction, and has left the ridges and folds above described as marks of its action, and corresponding with the appearances before observed in the Crinoidea, especially in *Actinocrinites* and *Cyathocrinites*.

* I am now doubtful, however, whether it might not be preferable to consider this plate as analogous to the upper columnar joint of the Crinoidea, the next series as the pelvis, &c. in the manner proposed in the end of this article; but the letters of reference employed in the plate rendered it necessary to retain the above description also.

In each of the horse-shoe-like depressions traversed by a perforated ridge at the summit of the scapulæ, is inserted the first ARM JOINT, of similar contour to the depression, to whose superior surface adheres a CUNEIFORM JOINT, (considered by Mr. MANTELL as analogous to the os humeri) and indicating that the arm here divides, and sends off fingers in a manner analogous to what we observe in the Crinoidea.

The space between the superior angles of the scapulæ, is occupied by numerous small polygonal plates, analogous to those noticed in the genus Actinocrinites; these indicate that, as in those animals, an integument protected by numerous plates containing in its centre the mouth, extended over the abdominal cavity containing the viscera. This is the more strongly confirmed by a fine specimen in Mr. MANTELL's possession, and engraved for his work, PL. XVI. fig. 6. which also suggests the probability that the animal was capable of contracting this integument into the form of an imperfect proboscis.

In two specimens which I have had an opportunity of examining, the angular points of two of the costal plates where adhering to the central piece, are, as well as the latter, truncated and otherwise distorted, admitting an additional plate, the result of injury and restoration. But, even in this instance, nature has not interrupted the general principle of muscular action, continuing it over the interposed plate which is marked with ridges similar to the costals.

The remains of this species as already observed, occur only in chalk-pits, and show on fracture, that they are now converted into calcareous spar, thus resembling the appearance of the fracture of Pentacrinites, Asteria, and Echini, found in similar strata, and thereby proving the analogy which the calcareous concretions or ossicula of these animals bore originally to each other.

I entertain the hope that the parts of this animal of which I have been myself unable to speak with certainty, will be fully defined by Mr. MANTELL, who, by his vicinity to the chalk-pits where it occurs, has every opportunity of obtaining information and following up his inquiries.

I cannot omit to remark that there exists a considerable analogy in the arrangement of the plates forming the cup-like portion of Marsupites and

Cyathocrinites, which I hesitated to point out before I had proved the non-existence of the column in Marsupites. If we consider the lower pentangular plate in this genus (which is similar in position to that in Comatula) to serve in both as a keystone to their vaulted cup, or as a plate performing in part the office of a first columnar joint, (since the other plates adhere to its edges) and thus apply the anatomical nomenclature used when describing the Cyathocrinites, we shall find the five plates forming the pelvis in that genus truly conformable to the five costals in Marsupites, differing only in their upper edges being bent, to form as it were a concave rim, and the lower surface being excavated to give articulation to the column. The five intercostal plates in Marsupites correspond in figure and marking with the five costals in Cyathocrinites, and the scapulæ, integument, and commencement of the arms exhibit a conformity conspicuous at first sight. It is truly pleasing by this change of anatomical nomenclature, to point out in a more striking manner the method in which nature effects the transition from one being to another. In the Comatula, the absence of the column showed the first link from the Crinoidea articulata to the Stelleridæ, in the Marsupite a similar link is offered from the Crinoidea inarticulata to that family.

CONCLUSION.

The interesting fact observed in the Crinoides of the preservation of the investing muscular membrane, and the retention of the form produced by its various contractions in a fossil state, which has been proved by the detailed description of its traces in various specimens, created a wish to discover whether similar traces might not likewise exist in the fossil Echinodermata; since in these animals the plates inclosing the viscera are covered by an investing muscular membrane considerably analogous to that of the Crinoides, and employed in communicating motion to the spines, and in considering the figure of the Echinodermata, and the Crinoides, I discovered that by reversing the arms upper and lower surface (as usually applied) and by placing the animal with its mouth upwards, a greater analogy than I

ADDENDA TO THE GENUS PENTACRINITES.

Mr. JAMES SOWERBY, of Lambeth, has kindly presented me with fragments of the column of a Pentacrinite, found by him in the London clay, about 6 or 8 years ago, at White Conduit-House, Islington; adding that they also, though rarely, occur at Richmond, and have been met with in digging a well at Kensington; but he further remarks that they are generally so much impregnated with pyritical matter that they soon decompose and fall to pieces.

These columns much resembles in size and shape those of *Pentacrinites basaltiformis*, but have the angles more rounded. From their exhibiting no marks of muscular corrugation at their exterior surface, and the joints being of uniform thickness, I apprehend the fragments before me to be full grown columnar portions. I wave distinguishing it as a species, not having the means of furnishing a specific character; yet, should it prove such, I should propose for it the name *Pentacrinites subbasaltiformis*.

I apprehend this is the same species which is mentioned in Dr. WOODWARD's catalogue of the additional English native fossils, vol. II. p. 51. x. d. 58. to 60. as having been found in the same stratum.

CONCLUSION.

The interesting fact observed in the Crinoidea of the preservation of the investing muscular membrane, and the retention of the form produced by its various contractions in a fossil state, which has been proved by the detailed description of its traces in various specimens, created a wish to discover whether similar traces might not likewise exist in the fossil Echini and Cidares; since in these animals the plates inclosing the viscera are covered by an investing muscular membrane considerably analogous to that of the Crinoidea, and employed in communicating motion to the spines.

Considering the figure of the Echini and Cidares attentively, I discovered that by reversing the terms upper and lower surface (as usually applied) and by placing the animal with its mouth upwards, a greater analogy than I

expected between it and the cup-like portion of the Crinoidea inarticulata, the Comatula, Marsupites, and Euryale, became apparent.

The five plates at the bottom of the cup thus presented, pierced for the passage of the oviducts, appeared to represent the pelvis, on which the plates forming the area and areolæ are arranged in series analogous to costals and intercostals of the former, and from these (the scapulæ and arms being deficient in this order) a plated integument extends across the abdominal cavity inclosing in the centre the mouth; this, however, is armed with five teeth, inserted in a complicated ossicular apparatus, a character which, as far as my knowledge extends, does not appear to have been possessed by any of the Crinoidea.

It is evident that the original texture of the ossicular plates of the Crinoidea, Stelleridæ, and Echini, must have been similar, since the same peculiar structure of calcareous spar is exhibited in the fossil remains of all these substances.

As the muscular integument over the plates does not extend over the whole shell in an uninterrupted line as in the Crinoidea, where it is intended to effect the movement of the arms, but is limited to short spaces from tubercle to tubercle, each muscle having for its office the erection of a single spine, a similar conspicuous appearance cannot be expected.

In recent specimens of *Cidaris imperialis*, we notice slight radiating ridges on the areas surrounding the mamillæ, evidently the result of the depression of the calcareous matter during secretion, in consequence of the frequently repeated contracting action of the fibres of the radiating muscle.

In fossil specimens of a similar *Cidaris* occurring in the coral rag, and figured in PARKINSON'S Organic Remains, Vol. III. PL. I. fig. 9. we trace sometimes immediately below the mamilla a radiating marking. Is this not the muscle in a petrified state?

The corrugation of the muscular membrane investing the regions round the vent, and the undeveloped spines near it, is, I apprehend, the cause of the singular appearance exhibited by some fossil specimens of a *Cidarites* from Wiltshire, as represented by Mr. PARKINSON, in his Org Remains, Vol. III. PL. I. fig. 13.

Geological Distribution of the Crinoidea.

I. Division. Articulata.										II. Division. Semi-artic.										III. Division. Inarticulata.										IV. D. Coarctata?										ADDENDA.										New Species in v. Schlot.																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
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Crinoidal impressions.										13. Screwstones.										Eucrinites mespiliformis.										 calycularis.																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															
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Recent.

Formations above the Chalk.
and London Clay.

Chalk formation.

Greensand formation.

Portland Oolite.*

Cornbrash and Forest Marble.

Clay over the great Oolite.

Great Oolite.

Inferior Oolite.

Lias.

Magnesian Limestone.†

Mountain Limestone.

Transition Limestone.

Upper Bed of the Greywacke.

* Microscopic fragments of a Pentacrinite have been found in these beds at Brill, Buckingham, but the species could not be ascertained.

† In the neighbourhood of Bristol this rock being associated with a conglomerate derived from the mountain limestone, contains probably all that occur in mountain limestone

‡ Probably in all the strata where Crinoidea occur.

Observation on the Plates.

The first requisite in plates illustrative of subjects in natural history is, undoubtedly, that they should represent with fidelity the object under investigation, convey a correct idea of the whole, exhibit in a marked manner the generic and specific characters, and display the anatomical details in different points of view. The faithful execution and accomplishment of these objects, will generally plead an apology in the estimation of those whose object is scientific knowledge, for the want of that peculiar delicacy and finish in execution which is within the reach of the practised artist alone.

In the plates representing the generic character of the Crinoidea, I have endeavoured by figuring separately the several parts of the cup-like portion of the animal, yet preserving them in their natural series, to convey an idea of the manner in which they are placed over and near each other in the living animal, the dotted lines directing the eye to their points of adhesion and insertion. In all these generic plates I have shaded, and in the Crinoidea inarticulata also coloured differently from the rest, those plates or joints essential to the generic character, endeavouring by this means at once to direct the eye to these parts. This, I believe, is a mode of representation not hitherto attempted in plates on natural history, the public will judge of its effect. I have applied it to other subjects of natural history, and found it very useful where the character of the genus or species is well defined, where this is not the case, it has frequently led me to a further examination of the subject I have wished to represent, and thus furnished some interesting results.

I have supplied from the combination of numerous specimens, a restored figure of some of the Crinoidea, such as I conceive them to have been when living, venturing, however, to indulge no further in this conjectural process,

than the results derived from my inquiry into their organic formation would fully warrant. I have in some instances, particularly in the representations of the tentaculated fingers, figured specimens as perfect, where well preserved portions furnished me with data sufficiently clear and demonstrative, and thus enabled me to save the reader the irksomeness and trouble of deciphering for himself mutilated fragments. I have in most instances omitted the representation of the surrounding matrix, as unessential to a history of the organic formation of the animals.

I have followed in all these points M. CUVIER, who, in arranging the bones of the Paris bason, was enabled by his great knowledge of comparative anatomy, to appropriate each single bone to its proper species and place, and thus to re-unite and restore perfect skeletons from the scattered members dispersed in various separate blocks. By pursuing this method, he has enabled every one tolerably acquainted with the subject, to form a general and correct idea of the form of these long extinct species, and to assign to them their true places and stations in the systematic order of nature, purposes which must obviously have been accomplished in a far less satisfactory manner, even if they had not entirely failed, had he contented himself by figuring each separate slab, a process by which the most essential features would have been lost, and buried beneath the accumulation of unessential details.

I would indeed generally remark that I must always consider the representations of mutilated fossil specimens imbedded in their mineral matrix, prejudicial to the advancement of a real knowledge of organic remains, whenever sufficient certainty can be obtained to effect a perfect restoration of the object without risking conjectural additions. This practice, at best, affords only a fairer opportunity to the artist for the display of his art, while it materially detracts from the information which the representation is calculated to afford to the physiological inquirer, who by a general figure acquires at once an idea of the whole animal, and is at the same time enabled to judge of its correctness, by referring to the representations of the anatomical details, and to those general laws of organization which belong to the classes most nearly approximating in structure to the individuals under examination.

In pursuance of the plan adopted in modern publications on natural history, by M. CUVIER, M. SAVIGNY, &c. I have used letters and signs denoting

in all the plates the analogous parts in each species of Crinoidea, the Marsupites, and Comatulæ. Their application is as follows:—

- A Superior portion of the animal.
- Æ Column.
- B Base of attachment.
- C Fibres of attachment.
- D Auxiliary side arms.
- E Pelvis.
- F Costal plate or joint.
- G Intercostal plate or joint.
- H Scapula.
- I Interscapular plate or joint.
- J Irregular interscapular plate.
- K Arms.
- L Cuneiform joint.
- M The hand.
- N The Finger.
- O Tentacula.
- œ Excavation in the arm joints, fingers, and tentacula, for the passage of viscera, covered by the plated integument.
- P Clavicle.
- Q Pectoral plates.
- R Capital plates.
- S Mouth capable of being protruded into an elongated proboscis, by the sphincter contraction of the plated integument.
- T Plated integument covering the abdominal cavity, and the excavation in the arms, fingers, and tentacula.
- V Alimentary canal.
- U Exuded indurated calcareous matter.
- UE Entrance to the alimentary canal.
- W Impression of the auxiliary arm joints on the column.
- X Orifice of the mouth.
- Y Supposed aperture of the ovary.
- Z Undeveloped muscular cartilaginous parts.

- A* Sphincter Muscle.
- AE* Perforation for the Passage of nourishing Vessels.
- F* Ridges the effect of muscular contraction.
- G* Corrugated Muscle.
- I* Reproduced Parts.
- K* Radiated insertion.
- N* Ridge-like insertion.
- Q* Muscle which has slid from its regular position or is displaced.
- R* Place where the Arms are broken off.
- S* Place where the Fingers are broken off.
- U* Undulated insertion.
- W.* Trefoil-shaped elevation on the truncated point of the pelvis, costals, and other joints.
- X* Depressing Muscle.
- Z* Aperture between the joints under the plated integument.
- a* First.
- b* Second.
- d* Joint or Plate.
- f* Enlarged.
- g* Crenulated suture.
- j* Irregular joint, the result of injury sustained by the membrane or periosteum which secreted the calcareous matter.
- k.* Superior surface.
- l* Inferior surface.

- m* Lateral edge.
- n* Marks of increase or growth.
- s* Contraction.
- f.* Places where the calcareous deposits from the periosteum formed in layers one over the other, have separated or decorticated.
- v.* Single.
- w.* Double.
- x* Insertion.
- y* & $\square$. Section.
- ae* Triangular perforated ridge.
- — Muscular envelopment.
- — Muscular elongation.
- = Sphincter contraction.
- z Perforated tubercle.
- $\triangle$ Larger than natural size, the number of inscribed triangles points out how many times magnified; this sign is not always used, as its employment in one instance on a plate gives a criterion for all the conformable parts.
- xx** Twisting contraction produced by muscular action.
- xxx** Undulating contraction.

*Enumeration of the Plates, illustration of some of the Figures,
and Direction to the Binder.*

PLATE

— Genus. *Apiocrinites* to face page 17.

I. *Apiocrinites rotundus*, p. 19.

Figure 2. represents a fine specimen in my possession. I have indicated the probable form of the fingers by dotted lines, having only seen portions of them, but none that could furnish full information of their complete outline. I have indeed seen fingers made up by gluing together finger-joints found at various distances from each other in the Bradford clay, and arranged in a decreasing order; but as in the Crinoidea each finger-joint is not distinguished by an essential character as in those of Mammalia, such a representation may prove only deceptive.

II. *Apiocrinites rotundus*, p. 21.

III. *Apiocrinites rotundus*, p. 25.

IV. *Apiocrinites rotundus*, p. 26.

Fig. 14. 20. and 21. are magnified representations.

V. *Apiocrinites rotundus*, p. 27.

VI. *Apiocrinites rotundus*, p. 28.

VII. *Apiocrinites rotundus*, p. 32.

Fig. 13. shows the supposed aperture of the ovaries in a specimen drawn on an extended line.

— *Apiocrinites ellipticus*, p. 34.

I. *Encrinites moniliformis*, p. 39.

Smaller than natural.

II. *Encrinites moniliformis*, p. 40.

Larger than natural.

III. *Encrinites moniliformis*, p. 41.

— Genus. *Pentacrinites* vel *Pentacrinus*, p. 45.

I. *Pentacrinus Caput Medusæ*, p. 48.

Represents the upper part of Mr. TOBIN's specimen rather larger than natural size, with its fingers and arms affixed. In the specimen these are broken off with the exception of the reproduced arm.

PLATE

II. *Pentacrinus Caput Medusæ*, p. 51.

All the figures, with the exception of 18. to 22. are considerably larger than natural.

I. *Pentacrinites Briareus*, p. 56.II. *Pentacrinites Briareus*, p. 57.I. *Pentacrinites subangularis*, p. 59.II. { *Pentacrinites subangularis*,
 Pentacrinites basaltiformis, } p. 60.— *Pentacrinites tuberculatus*,* p. 64.— Genus. *Poteriocrinites*, p. 67.— *Poteriocrinites crassus*, p. 68.— *Poteriocrinites tenuis*, p. 71.— Genus. *Platycrinites*, p. 73.I. *Platycrinites lævis*, p. 74.II. *Platycrinites lævis*, p. 75.

Fig. 33. to 51. larger than natural size.

— *Platycrinites rugosus*, p. 79.— { *Platycrinites tuberculatus*,
 Platycrinites granulatus,
 Platycrinites striatus,
 Platycrinites pentangularis, } p. 81.— Genus. *Cyathocrinites*, p. 85.— *Cyathocrinites planus*, p. 86.— *Cyathocrinites tuberculatus*, p. 88.— *Cyathocrinites rugosus*, p. 90.— *Cyathocrinites quinquangularis*, p. 92.— Genus. *Actinocrinites*, p. 94.I. *Actinocrinites triaconta dactylus*, p. 96.II. *Actinocrinites triaconta dactylus*, p. 98.III. *Actinocrinites triaconta dactylus*, p. 99.

* I regret, when describing *Pentacrinites tuberculatus*, not to have stated particularly that its columnar joints when not fully formed, are like those of other *Pentacrinites*, considerably thinner than at a subsequent stage of growth, and alternately larger and smaller. I should also have further observed, that the exterior surface of the joints which, in the older specimens, as represented in the plate, is studded with irregular tubercles, has in these young and thinner ones only a single row of such tubercles ranging regularly round the middle. The cause of this appears to be that as these tubercles arise from the contraction of the investing muscular membrane, they are therefore more regular and distinct in the earlier and non-cartilaginous state of the joint.

PLATE.

- IV. *Actinocrinites triaconta dactylus*, p. 100.
 V. *Actinocrinites triaconta dactylus*, p. 101.
 VI. *Actinocrinites triaconta dactylus*, p. 102.
 I. *Actinocrinites poly dactylus*, p. 103.
 II. *Actinocrinites poly dactylus*, p. 104.
 — *Actinocrinites lævis*, p. 105.
 — Genus. *Rhodocrinites*, p. 106.
 I. *Rhodocrinites verus*, p. 107.
 II. *Rhodocrinites verus*, p. 108.
 — Genus. *Eugeniocrinites*, p. 111.
 — Unascertained crinoidal remains, p. 114.
 — *Comatula fimbriata*, Frontispiece.
 — Genus *Marsupites*, p. 134.

ERRATA.

PAGE 14 line 8 for five costal plates read five intercostal plates.

..... 15 16 for one intercostal plate read one irregular costal plate.

..... 17 15 for An animal read A Crinoidal animal.

..... 18 20 for fig. 1. and 14. read fig. 1. to 14.

..... — 22 for fig. 6. and 15. read fig. 6. to 15.

..... 45 4 for An animal with, read A Crinoidal animal having.

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